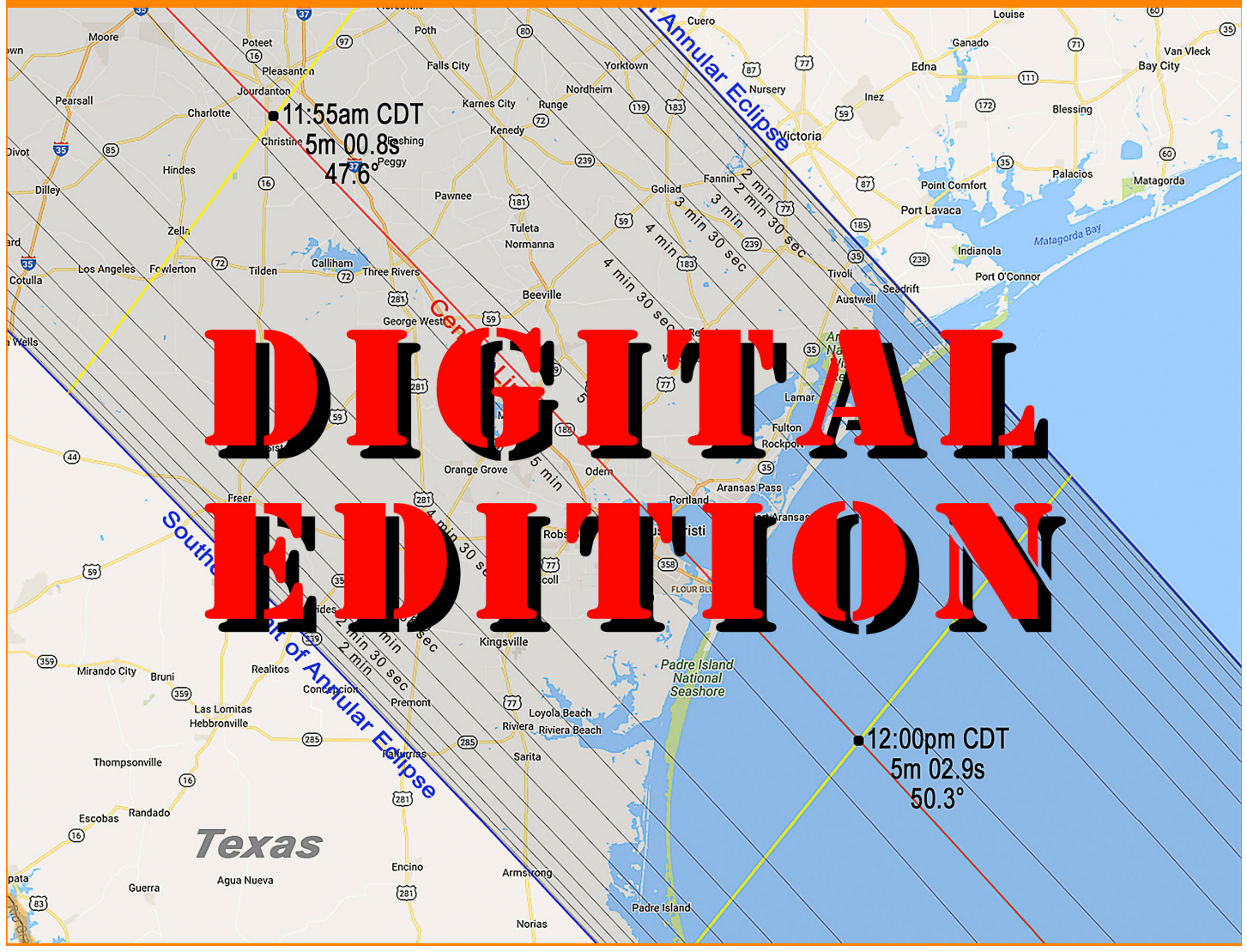


# Road Atlas for the Annular Solar Eclipse of 2023

**COLOR  
EDITION**

**Fred Espenak**



**Road Atlas**  
for the  
**Annular**  
**Solar Eclipse**  
of  
**2023**

**Color Edition**

**Fred Espenak**

Edition 1.0  
July 2018

Road Atlas for the Annular Solar Eclipse of 2023 – Color Edition

Copyright © 2018 by Fred Espenak

All rights reserved. No part of this publication may be reproduced, distributed, or transmitted in any form or by any means including photocopying, recording, or other electronic or mechanical methods, without the prior written permission of the publisher, except in the case of brief quotations embodied in critical reviews and certain other noncommercial uses permitted by copyright law. For permission requests, write to the publisher at the address below.

Astropixels Publishing  
P.O. Box 16197  
Portal, AZ 85632

Astropixels Publishing Website: [astropixels.com/pubs](http://astropixels.com/pubs)

This book may be ordered at: [astropixels.com/pubs/Atlas2023.html](http://astropixels.com/pubs/Atlas2023.html)

Printed in the United States of America

ISBN 978-1-941983-17-1

Astropixels Publication: AP017 (Version 1.0b)

First Edition

Front Cover: A map of the 2023 eclipse path in the vicinity of the Texas Gulf Coast illustrates the cartographic features found in the ***Road Atlas for the Annular Solar Eclipse of 2023 – Color Edition***.  
Map copyright © 2018 by Fred Espenak. More about the eclipse can be found at:

[eclipsewise.com/solar/SEnews/ASE2023.html](http://eclipsewise.com/solar/SEnews/ASE2023.html)

Back Cover Photo of Fred Espenak: Copyright © 2016 by Fred Espenak

## Table of Contents

<b>1 - INTRODUCTION</b> .....	<b>5</b>
<b>2 - LOCAL CIRCUMSTANCES FOR THE ECLIPSE</b> .....	<b>6</b>
TABLE 1 - LOCAL CIRCUMSTANCES FOR THE ANNULAR ECLIPSE IN THE USA .....	6
TABLE 2 - LOCAL CIRCUMSTANCES FOR THE PARTIAL ECLIPSE IN THE USA .....	7
TABLE 3 - LOCAL CIRCUMSTANCES FOR THE PARTIAL ECLIPSE IN CANADA.....	8
TABLE 4 - LOCAL CIRCUMSTANCES FOR THE PARTIAL ECLIPSE IN MEXICO AND CENTRAL AMERICA.....	8
TABLE 5 - LOCAL CIRCUMSTANCES FOR THE PARTIAL ECLIPSE IN SOUTH AMERICA.....	9
TABLE 6 - LOCAL CIRCUMSTANCES FOR THE ANNULAR ECLIPSE IN CENTRAL & SOUTH AMERICA .....	9
<b>3 - GLOBAL MAP OF THE ECLIPSE</b> .....	<b>10</b>
<b>4 - OVERVIEW MAPS OF THE PATH OF ANNULARITY</b> .....	<b>10</b>
<b>5 - DETAILED MAPS OF THE PATH OF ANNULARITY</b> .....	<b>10</b>
GLOBAL MAP OF THE 2023 ANNULAR ECLIPSE .....	11
<b>6 - ECLIPSEWISE.COM WEB SITE</b> .....	<b>12</b>
<b>7 - ECLIPSEWISE.COM AND THE 2023 ANNULAR ECLIPSE</b> .....	<b>12</b>
<b>8 - TOTAL AND ANNULAR ECLIPSES IN THE USA AND CANADA: 2001 - 2050</b> .....	<b>13</b>
<b>9 - ECLIPSE PREDICTIONS</b> .....	<b>13</b>
<b>REGIONAL ECLIPSE MAPS</b> .....	<b>14</b>
OVERVIEW MAP 1: PATH OF THE ECLIPSE THROUGH WESTERN USA .....	14
OVERVIEW MAP 2: PATH OF THE ECLIPSE THROUGH CENTRAL AND SOUTH AMERICA.....	15
OVERVIEW MAP 3: PATH OF THE ECLIPSE THROUGH BRAZIL.....	16
<b>DETAILED ECLIPSE MAPS</b> .....	<b>17</b>
MAP 01: WESTERN OREGON — 9:20 AM PDT .....	17
MAP 02: CENTRAL OREGON — 9:20 AM PDT.....	18
MAP 03: EASTERN OREGON AND NORTHERN NEVADA .....	19
MAP 04: EASTERN NEVADA — 9:25 AM PDT .....	20
MAP 05: WESTERN UTAH.....	21
MAP 06: SOUTHERN UTAH — 10:30 AM MDT.....	22
MAP 07: UTAH/COLORADO/ARIZONA/NEW MEXICO — 10:35 AM MDT.....	23
MAP 08: CENTRAL NEW MEXICO — 10:40 AM MDT.....	24
MAP 09: NEW MEXICO AND TEXAS — 10:40 AM MDT .....	25
MAP 10: WESTERN TEXAS — 11:45 AM CDT .....	26
MAP 11: SOUTHERN TEXAS — 11:50 AM CDT.....	27
MAP 12: TEXAS / GULF COAST — 11:55 AM CDT.....	28
MAP 13: MEXICO / YUCATAN — 12:30 PM CDT .....	29
MAP 14: BELIZE AND HONDURUS — 12:40 PM CDT .....	30
MAP 15: HONDURUS AND NICARAGUA — 12:50 PM CDT.....	31
MAP 16: NICARAGUA, COSTA RICA AND PANAMA — 1:00 PM CDT .....	32
MAP 17: PANAMA — 2:15 PM EDT .....	33
MAP 18: WESTERN COLOMBIA — 1:35 PM EST .....	34
MAP 19: CENTRAL COLOMBIA — 1:45 PM EST.....	35
MAP 20: EASTERN COLOMBIA AND WESTERN BRAZIL — 1:55 PM EST .....	36
MAP 21: EASTERN COLOMBIA AND WESTERN BRAZIL — 3:00 PM AMT .....	37
MAP 22: WESTERN BRAZIL — 3:10 PM AMT.....	38

MAP 23: CENTRAL BRAZIL — 3:20 PM AMT .....	39
MAP 24: CENTRAL BRAZIL — 3:25 PM AMT .....	40
MAP 25: CENTRAL BRAZIL — 4:35 PM BRT .....	41
MAP 26: CENTRAL BRAZIL .....	42
MAP 27: CENTRAL BRAZIL — 4:40 PM BRT .....	43
MAP 28: EASTERN BRAZIL .....	44
MAP 29: EASTERN BRAZIL — 4:45 PM BRT .....	45



*The last annular solar eclipse visible from the contiguous USA was on May 20, 2012.  
The image above was shot from Elida, NM, where the annular phase occurred about 10 minutes before sunset.  
© 2012 F. Espenak, [www.MrEclipse.com](http://www.MrEclipse.com)*



*The rapidly changing geometry of the Sun and Moon over five minutes is revealed in the above composite of annularity. Left: just as annularity begins. Middle: mid-annularity. Right: just as annularity ends.*

*This sequence was captured during the annular solar eclipse of October 3, 2005 from Carrascosa del Campo, Spain.*

*© 2005 F. Espenak, [www.MrEclipse.com](http://www.MrEclipse.com)*

## 1 – Introduction

On Saturday, October 14, 2023, an annular eclipse of the Sun will be visible from the United States for the first time since May 20, 2012. Although a partial eclipse will be seen from all of North America, the annular phase in which the Moon's disk is completely silhouetted by the Sun (i.e., *annularity*) is only visible from a narrow path of the Moon's antumbral shadow as it sweeps through western USA, Mexico, Central and South America.

Because a bright ring of sunlight will surround the Moon during *annularity*, the Sun's faint solar corona will remain hidden. The only safe way to look directly at the eclipse is through special solar filters, such as "eclipse glasses" or hand-held solar viewers. This includes the annular phase of the eclipse.

The course of the Moon's shadow begins in the North Pacific and crosses the western USA, traversing parts of nine states<sup>1</sup>: Oregon, California, Idaho, Nevada, Utah, Colorado, Arizona, New Mexico, and Texas. The central path also crosses Mexico's Yucatan Peninsula, and parts of six Central American nations: Guatemala, Belize, Honduras, Nicaragua, Costa Rica, and Panama. Finally, the path of annularity sweeps across Colombia and Brazil before ending in the Atlantic Ocean. The width of the *path of annularity* ranges from 137 miles (220 km) in Oregon to 115 miles (184 km) in Mexico and Belize.

The duration of annularity also varies along the path being longest in Panama (5 minutes 17 seconds) and shortest in east Brazil (4 minutes 20 seconds). These durations are for the middle of the path (*central line*). As one moves away from the *central line*, the duration of *annularity* decreases. It happens slowly at first but drops rapidly to *zero* at the northern or southern edges or limits of the *path of annularity*.

Observing from the central line of the eclipse offers the longest possible duration of annularity. Alternatively, positioning an observer just inside the northern or southern limits shortens annularity but prolongs the appearance of Baily's beads. In either case, this collection of maps will assist eclipse observers in locating the exact position of the path of annularity.

<sup>1</sup> Only a small corner of southwestern Idaho lies in the path of annularity.

## 2 – Local Circumstances for the Eclipse

Local circumstances for the eclipse appear in Tables 1 through 6. All times are given in local time and include Daylight Saving Time (where applicable). The Sun's altitude is given at the instant of maximum eclipse. *Eclipse Magnitude* is the fraction (in percent) of the Sun's *diameter* covered by the Moon at maximum eclipse.

The circumstances for a number of U.S. cities appear in Table 1 (annular eclipse) and Table 2 (partial eclipse). Cities in Canada are found in Table 3 (partial eclipse), and Mexico and Central America in Table 4 (partial eclipse). Finally, circumstances for major cities in South America are listed in Tables 5 (partial eclipse) and 6 (annular eclipse).

**Table 1 - Local Circumstances for the Annular Eclipse in the USA**

State/City	Partial Eclipse Begins	Annular Eclipse Begins	Annular Eclipse Ends	Partial Eclipse Ends	Duration Of Annularity	Sun Altitude
<b>OREGON</b>						
<b>Coos Bay</b>	08:04:57 am	09:16:01 am	09:20:03 am	10:38:39 am	04m03s	18°
<b>Corvallis</b>	08:05:35 am	09:17:57 am	09:19:44 am	10:39:26 am	01m47s	18°
<b>Eugene</b>	08:05:27 am	09:16:59 am	09:20:47 am	10:39:46 am	03m49s	18°
<b>Klamath Falls</b>	08:05:17 am	09:17:57 am	09:21:18 am	10:41:47 am	03m21s	20°
<b>Medford</b>	08:05:01 am	09:18:21 am	09:19:20 am	10:40:26 am	00m59s	19°
<b>Roseburg</b>	08:05:07 am	09:16:25 am	09:20:47 am	10:39:41 am	04m21s	18°
<b>Springfield</b>	08:05:27 am	09:17:00 am	09:20:51 am	10:39:50 am	03m51s	18°
<b>NEVADA</b>						
<b>Elko</b>	08:07:14 am	09:22:27 am	09:26:46 am	10:50:07 am	04m19s	25°
<b>NEW MEXICO</b>						
<b>Albuquerque</b>	09:13:08 am	10:34:26 am	10:39:16 am	12:09:21 pm	04m50s	36°
<b>Artesia</b>	09:15:58 am	10:39:56 am	10:43:33 am	12:16:23 pm	03m36s	40°
<b>Carlsbad</b>	09:16:21 am	10:41:33 am	10:43:12 am	12:17:19 pm	01m39s	40°
<b>Farmington</b>	09:11:40 am	10:31:49 am	10:36:08 am	12:04:55 pm	04m19s	34°
<b>Gallup</b>	09:11:38 am	10:33:02 am	10:35:07 am	12:05:22 pm	02m05s	34°
<b>Hobbs</b>	09:17:07 am	10:41:10 am	10:46:05 am	12:18:53 pm	04m55s	41°
<b>Los Alamos</b>	09:13:14 am	10:35:13 am	10:38:22 am	12:08:58 pm	03m09s	36°
<b>Roswell</b>	09:15:35 am	10:38:43 am	10:43:24 am	12:15:22 pm	04m41s	39°
<b>Santa Fe</b>	09:13:25 am	10:35:51 am	10:38:39 am	12:09:43 pm	02m48s	36°
<b>TEXAS</b>						
<b>Alamo</b>	10:23:43 am	11:51:51 am	11:56:25 am	01:32:50 pm	04m34s	47°
<b>Alice</b>	10:25:45 am	11:55:09 am	11:59:18 am	01:36:57 pm	04m09s	49°
<b>Andrews</b>	10:17:50 am	11:42:22 am	11:47:18 am	01:20:31 pm	04m55s	42°
<b>Beeville</b>	10:25:30 am	11:54:23 am	11:59:18 am	01:36:21 pm	04m55s	49°
<b>Big Spring</b>	10:18:52 am	11:44:42 am	11:48:11 am	01:22:34 pm	03m28s	42°
<b>Corpus Christi</b>	10:26:27 am	11:55:46 am	12:00:48 pm	01:38:13 pm	05m02s	49°
<b>Ingleside</b>	10:26:34 am	11:55:59 am	12:00:55 pm	01:38:23 pm	04m56s	49°
<b>Kerrville</b>	10:22:38 am	11:50:20 am	11:54:35 am	01:30:38 pm	04m15s	46°
<b>Kingsville</b>	10:26:13 am	11:55:52 am	11:59:57 am	01:37:49 pm	04m04s	49°
<b>Lamesa</b>	10:18:08 am	11:43:42 am	11:46:47 am	01:20:54 pm	03m05s	42°
<b>Midland</b>	10:18:27 am	11:43:22 am	11:48:17 am	01:21:52 pm	04m55s	42°
<b>Odessa</b>	10:18:15 am	11:43:07 am	11:47:57 am	01:21:32 pm	04m49s	42°
<b>Portland</b>	10:26:26 am	11:55:45 am	12:00:45 pm	01:38:09 pm	05m00s	49°
<b>Robstown</b>	10:26:10 am	11:55:24 am	12:00:18 pm	01:37:42 pm	04m54s	49°
<b>San Angelo</b>	10:20:18 am	11:47:11 am	11:50:21 am	01:25:43 pm	03m10s	44°
<b>San Antonio</b>	10:23:48 am	11:52:03 am	11:56:28 am	01:32:59 pm	04m25s	47°
<b>Schertz</b>	10:23:58 am	11:52:51 am	11:56:07 am	01:33:13 pm	03m15s	47°
<b>Uvalde</b>	10:22:40 am	11:50:34 am	11:54:29 am	12:30:55 pm	03m55s	46°

**Table 2 - Local Circumstances for the Partial Eclipse in the USA**

City, State	Partial Eclipse Begins	Maximum Eclipse	Partial Eclipse Ends	Eclipse Magnitude	Sun Altitude
Albany, NY	12:10:12 pm	01:20:35 pm	02:31:16 pm	32%	38°
Atlanta, GA	11:43:10 am	01:12:18 pm	02:45:09 pm	62%	48°
Augusta, ME	12:22:41 pm	01:25:52 pm	02:28:39 pm	25%	36°
Austin, TX	10:23:59 am	11:54:22 am	01:32:48 pm	93%	47°
Baltimore, MD	12:01:26 pm	01:19:25 pm	02:38:22 pm	41%	42°
Baton Rouge, LA	10:32:31 am	12:04:56 pm	01:43:35 pm	80%	50°
Birmingham, AL	10:38:29 am	12:08:16 pm	01:42:40 pm	67%	48°
Bismarck, ND	10:21:23 am	11:38:39 am	01:01:25 pm	64%	30°
Boise, ID	09:07:43 am	10:23:59 am	11:47:49 am	90%	23°
Boston, MA	12:18:07 pm	01:25:57 pm	02:33:29 pm	29%	38°
Charleston, SC	11:53:29 am	01:22:09 pm	02:52:52 pm	56%	49°
Chicago, IL	10:37:21 am	11:58:06 am	01:22:45 pm	54%	39°
Columbus, OH	11:46:05 am	01:07:18 pm	02:31:22 pm	50%	42°
Concord, NH	12:16:54 pm	01:23:59 pm	02:30:54 pm	28%	37°
Dallas, TX	10:23:35 am	11:52:50 am	01:29:39 pm	86%	45°
Denver, CO	09:13:59 am	10:36:07 am	12:05:59 pm	85%	33°
Des Moines, IA	10:27:29 am	11:49:38 am	01:17:11 pm	64%	38°
Detroit, MI	11:46:45 am	01:04:55 pm	02:25:43 pm	46%	39°
El Paso, TX	09:15:05 am	10:39:57 am	12:14:01 pm	90%	39°
Fargo, ND	10:26:13 am	11:43:11 am	01:05:00 pm	58%	31°
Hartford, CT	12:13:02 pm	01:23:37 pm	02:34:14 pm	32%	39°
Houston, TX	10:27:10 am	11:58:53 am	01:38:05 pm	90%	49°
Jackson, MS	10:33:03 am	12:04:04 pm	01:40:54 pm	75%	48°
Kansas City, MO	10:25:27 am	11:50:04 am	01:20:47 pm	70%	40°
Knoxville, TN	11:43:45 am	01:10:14 pm	02:40:10 pm	58%	46°
Las Vegas, NV	08:08:02 am	09:26:38 am	10:54:10 am	87%	29°
Lincoln, NE	10:23:02 am	11:45:59 am	01:15:07 pm	70%	37°
Little Rock, AR	10:28:57 am	11:57:38 am	01:32:31 pm	74%	45°
Los Angeles, CA	08:07:57 am	09:24:31 am	10:50:07 am	78%	28°
Louisville, KY	11:40:02 am	01:04:26 pm	02:32:41 pm	57%	43°
Madison, WI	10:34:48 am	11:54:37 am	01:18:36 pm	55%	38°
Memphis, TN	10:32:24 am	12:00:48 pm	01:34:42 pm	70%	45°
Miami, FL	11:57:20 am	01:33:49 pm	03:11:50 pm	67%	55°
Milwaukee, WI	10:37:26 am	11:56:50 am	01:20:02 pm	53%	38°
Nashville, TN	10:38:01 am	12:05:02 pm	01:36:26 pm	62%	45°
New Orleans, LA	10:34:32 am	12:07:32 pm	01:46:27 pm	79%	51°
New York, NY	12:08:53 pm	01:22:27 pm	02:36:18 pm	35%	40°
Oklahoma City, OK	10:21:48 am	11:48:58 am	01:23:29 pm	82%	42°
Philadelphia, PA	12:05:31 pm	01:21:17 pm	02:37:38 pm	37%	41°
Phoenix, AZ	08:10:43 am	09:31:34 am	11:01:40 am	85%	33°
Portland, ME	12:20:53 pm	01:25:43 pm	02:30:11 pm	26%	36°
Portland, OR	08:06:10 am	09:19:25 am	10:39:50 am	91%	18°
Providence, RI	12:16:55 pm	01:25:58 pm	02:34:47 pm	30%	38°
Raleigh, NC	11:56:00 am	01:20:14 pm	02:46:04 pm	49%	46°
Richmond, VA	11:59:01 am	01:20:03 pm	02:42:20 pm	44%	44°
Salem, OR	08:05:48 am	09:19:04 am	10:39:36 am	93%	18°
Salt Lake City, UT	09:09:12 am	10:28:17 am	11:55:24 am	92%	28°
San Francisco, CA	08:05:17 am	09:19:29 am	10:42:07 am	83%	22°
Seattle, WA	08:07:31 am	09:20:11 am	10:39:35 am	86%	17°
Springfield, IL	10:33:11 am	11:56:46 am	01:25:05 pm	61%	41°
Washington, DC	12:00:13 pm	01:19:06 pm	02:39:06 pm	42%	43°



**Table 3 - Local Circumstances for the Partial Eclipse in Canada**

City, State	Partial Eclipse Begins	Maximum Eclipse	Partial Eclipse Ends	Eclipse Magnitude	Sun Altitude
Calgary, AB	09:14:13 am	10:26:51 am	11:45:09 am	70%	20°
Charlottetown, PE	01:45:10 pm	02:35:23 pm	03:24:43 pm	15%	31°
Edmonton, AB	09:17:33 am	10:28:19 am	11:44:03 am	63%	18°
Fredericton, NB	01:33:13 pm	02:29:25 pm	03:24:57 pm	19%	33°
Halifax, NS	01:43:13 pm	02:36:48 pm	03:29:21 pm	17%	33°
Hamilton, ON	11:54:26 am	01:09:20 pm	02:25:57 pm	40%	39°
Inuvik, NW	-	10:33:02 am	11:32:22 am	44%	3°
Iqaluit, NU	12:37:38 pm	01:11:39 pm	01:45:38 pm	9%	17°
Lethbridge, AB	09:13:38 am	10:27:25 am	11:47:09 am	72%	21°
London, ON	11:51:04 am	01:07:17 pm	02:25:36 pm	43%	39°
Montréal, QC	12:11:56 pm	01:17:46 pm	02:23:53 pm	28%	36°
Ottawa, ON	12:06:02 pm	01:14:14 pm	02:23:09 pm	31%	36°
Prince George, BC	08:13:26 am	09:22:50 am	10:37:27 am	71%	13°
Québec, QC	12:19:18 pm	01:20:25 pm	02:21:27 pm	24%	34°
Regina, SK	10:20:47 am	11:34:37 am	12:53:32 pm	61%	25°
Saint John's, NF	02:54:11 pm	03:21:28 pm	03:48:20 pm	5%	25°
Saskatoon, SK	10:20:55 am	11:33:10 am	12:50:14 pm	60%	23°
Sault St. Marie, ON	11:46:30 am	12:59:48 pm	02:15:34 pm	42%	35°
Thunder Bay, ON	11:38:51 am	12:52:06 pm	02:08:31 pm	46%	32°
Toronto, ON	11:55:45 am	01:09:44 pm	02:25:19 pm	39%	38°
Vancouver, BC	08:08:32 am	09:20:18 am	10:38:25 am	82%	15°
Victoria, BC	11:07:47 am	12:19:50 pm	01:38:25 pm	85%	16°
Winnipeg, MB	10:28:33 am	11:42:16 am	01:00:14 pm	53%	29°
Windsor, ON	11:46:48 am	01:04:59 pm	02:25:49 pm	46%	39°
Yellowknife, NW	09:31:21 am	10:33:36 am	11:38:44 am	46%	12°
Whitehorse, YU	-	09:23:49 am	10:31:00 am	62%	4°

**Table 4 - Local Circumstances for the Partial Eclipse in Mexico and Central America**

City	Partial Eclipse Begins	Maximum Eclipse	Partial Eclipse Ends	Eclipse Magnitude	Sun Altitude
<b>MEXICO</b>					
Ciudad Juarez	09:15:07 am	10:39:59 am	12:14:03 pm	90%	39°
Guadalajara	09:31:04 am	10:59:43 am	12:37:16 pm	71%	52°
Leon	09:31:30 am	11:01:51 am	12:40:56 pm	75%	53°
Mexico City	09:36:26 am	11:09:22 am	12:50:22 pm	77%	57°
Monterrey	09:25:50 am	10:56:38 am	12:36:09 pm	87%	50°
Puebla	09:38:02 am	11:11:52 am	12:53:29 pm	78%	58°
San Luis Potosi	09:30:18 am	11:01:14 am	12:40:52 pm	79%	53°
Tijuana	09:09:21 am	10:26:37 am	11:53:06 am	76%	30°
Toluca	09:36:22 am	11:08:45 am	12:49:18 pm	76%	57°
Torreon	09:23:28 am	10:51:50 am	12:29:24 pm	81%	47°
<b>COSTA RICA</b>					
San Jose	10:15:11 am	12:00:51 pm	01:46:06 pm	93%	69°
<b>EL SALVADOR</b>					
San Salvador	09:58:52 am	11:40:56 am	01:26:32 pm	88%	68°
<b>GUATEMALA</b>					
Guatemala	09:55:05 am	11:36:04 am	01:21:26 pm	87%	67°
<b>NICARAGUA</b>					
Managua	10:06:36 am	11:50:44 am	01:36:27 pm	92%	69°
<b>PANAMA</b>					
Panama City	11:26:05 am	01:13:20 pm	02:56:56 pm	94%	66°

**Table 5 - Local Circumstances for the Partial Eclipse in South America**

Country/City	Partial Eclipse Begins	Maximum Eclipse	Partial Eclipse Ends	Eclipse Magnitude	Sun Altitude
<b>ARGENTINA</b>					
<b>Buenos Aires</b>	04:02:54 pm	04:43:42 pm	05:22:23 pm	13%	29°
<b>BOLIVIA</b>					
<b>La Paz</b>	01:55:42 pm	03:25:01 pm	04:44:01 pm	60%	44°
<b>BRAZIL</b>					
<b>Belém</b>	03:04:24 pm	04:32:44 pm	05:47:23 pm	83%	22°
<b>Belo Horizonte</b>	03:37:12 pm	04:49:32 pm	05:53:14 pm	59%	15°
<b>Brasília</b>	03:25:39 pm	04:45:41 pm	05:55:01 pm	72%	19°
<b>Fortaleza</b>	03:23:34 pm	04:42:44 pm	-	89%	10°
<b>Manaus</b>	02:40:35 pm	04:19:29 pm	05:43:39 pm	93%	37°
<b>Recife</b>	03:31:55 pm	04:47:17 pm	-	92%	6°
<b>Rio de Janeiro</b>	03:42:59 pm	04:50:31 pm	05:50:42 pm	51%	14°
<b>Santos</b>	03:41:53 pm	04:49:27 pm	05:49:45 pm	48%	17°
<b>São Paulo</b>	03:40:50 pm	04:49:17 pm	05:50:16 pm	49%	18°
<b>CHILE</b>					
<b>Santiago</b>	03:56:12 pm	04:33:57 pm	05:10:12 pm	10%	41°
<b>COLOMBIA</b>					
<b>Bogota</b>	11:48:20 am	01:36:15 pm	03:15:26 pm	93%	59°
<b>ECUADOR</b>					
<b>Quito</b>	11:51:15 am	01:37:42 pm	03:16:57 pm	85%	64°
<b>PARAGUAY</b>					
<b>Asuncion</b>	03:32:52 pm	04:42:41 pm	05:45:20 pm	41%	29°
<b>PERU</b>					
<b>Lima</b>	12:29:13 pm	02:04:21 pm	03:31:02 pm	60%	58°
<b>URUGUAY</b>					
<b>Montevideo</b>	04:05:00 pm	04:45:02 pm	05:22:59 pm	13%	26°
<b>VENEZUELA</b>					
<b>Caracas</b>	12:56:00 pm	02:39:09 pm	04:11:30 pm	70%	49°

**Table 6 - Local Circumstances for the Annular Eclipse in Central & South America**

Country/City	Partial Eclipse Begins	Annular Eclipse Begins	Annular Eclipse Ends	Partial Eclipse Ends	Duration Annularity	Sun Altitude
<b>MEXICO</b>						
<b>Campeche</b>	10:45:24 am	12:22:22 pm	12:26:57 pm	02:09:23 pm	04m36s	61°
<b>Chetumal</b>	10:50:59 am	12:29:44 pm	12:34:08 pm	02:17:09 pm	04m24s	63°
<b>BELIZE</b>						
<b>Belize City</b>	09:52:53 am	11:31:44 am	11:36:55 am	01:19:46 pm	05m11s	64°
<b>HONDURAS</b>						
<b>La Ceiba</b>	09:58:14 am	11:38:24 am	11:43:36 am	01:26:42 pm	05m12s	66°
<b>NICARAGUA</b>						
<b>Bluefields</b>	10:11:12 am	11:53:55 am	11:59:10 am	01:41:58 pm	05m15s	68°
<b>COLOMBIA</b>						
<b>Buenaventura</b>	11:43:22 am	01:29:31 pm	01:32:53 pm	03:12:01 pm	03m23s	63°
<b>Cali</b>	11:45:37 am	01:31:35 pm	01:35:18 pm	03:13:46 pm	03m43s	62°
<b>Cartago</b>	11:43:46 am	01:30:13 pm	01:33:15 pm	03:12:11 pm	03m02s	61°
<b>Neiva</b>	11:49:33 am	01:34:48 pm	01:39:54 pm	03:16:42 pm	05m06s	60°
<b>Palmira</b>	11:45:57 am	01:31:27 pm	01:36:09 pm	03:14:01 pm	04m42s	62°
<b>BRAZIL</b>						
<b>Campina Grande</b>	03:30:04 pm	04:44:55 pm	04:47:59 pm	-	03m04s	7°
<b>Crato</b>	03:25:56 pm	04:43:09 pm	04:47:00 pm	-	03m52s	11°
<b>Joao Pessoa</b>	03:31:03 pm	04:45:09 pm	04:48:14 pm	-	03m05s	6°
<b>Natal</b>	03:29:26 pm	04:43:54 pm	04:47:27 pm	-	03m33s	6°
<b>Patos</b>	03:28:18 pm	04:43:50 pm	04:47:49 pm	-	03m59s	8°
<b>Santa Rita</b>	03:30:58 pm	04:45:09 pm	04:48:12 pm	-	03m03s	6°

The *2023 Annular Solar Eclipse Circumstances Calculator* is an interactive web page that can quickly calculate the local circumstances for the eclipse from any geographic location not included in Tables 1 through 6. The *Calculator* is located at: [www.EclipseWise.com/solar/SEcirc/2001-2100/SE2023Oct14Acirc.html](http://www.EclipseWise.com/solar/SEcirc/2001-2100/SE2023Oct14Acirc.html)

### 3 – Global Map of the Eclipse

The global map of Earth (page 12) illustrates the geographic extent of solar eclipse visibility. The limits of the Moon's penumbral shadow indicate the region where the partial solar eclipse is visible. This irregular, saddle-shaped region covers much of the daylight hemisphere of Earth and consists of several distinct zones. Great loops at the eastern and western ends (magenta curves) identify the areas where the eclipse begins/ends at sunrise and sunset, respectively. Bisecting the 'eclipse begins/ends at sunrise and sunset' loops is the curve of maximum eclipse at sunrise (western loop) and sunset (eastern loop).

The curves of maximum eclipse are given at each half-hour Universal Time. They run between the northern and southern limits of the penumbra. The curves of constant eclipse magnitude<sup>2</sup> identify points where the maximum eclipse magnitude has a constant value of 0.2, 0.4, 0.6 and 0.8. The annular eclipse path appears as a solid orange band. It is only within this zone that the annular eclipse is visible.

Additional data pertinent to the eclipse appear in the corners and at the bottom of the map. For a complete description of this information, see: [www.eclipsewise.com/oh/oh-help/SEdiskkey.html](http://www.eclipsewise.com/oh/oh-help/SEdiskkey.html)

### 4 – Overview Maps of the Path of Annularity

The three maps on pages 14-16 give a broad overview of the annular eclipse path through the USA, Mexico, Central and South America. The yellow lines running across the eclipse path mark the position of mid-eclipse at 10-minute intervals. The times are given in local time at each position along with the duration of annularity on the central line, and the altitude of the Sun above the horizon at that instant.

### 5 – Detailed Maps of the Path of Annularity

A detailed series of 29 maps (pages 17-45) covers the entire land-based path of annularity. The *Table of Contents* (page iii) can be used to quickly navigate to the map of interest since it lists the location of each map.

The map scale is approximately 1:1,800,000, which corresponds to 1 inch  $\approx$  28 miles (1 cm  $\approx$  18 km).<sup>3</sup> This large scale shows both major and minor roads, towns and cities, rivers, lakes, parks, national forests, wilderness areas and mountain ranges. A 50 mile (50 km) reference scale appears at the bottom of each map.

The path of annularity is depicted as a lightly shaded region with the northern and southern limits clearly labeled. The annular phase can be seen only inside this path (a partial eclipse is visible outside the path). The closer one gets to the central line, the longer the annular phase lasts. Gray lines inside the path mark the duration of the annular eclipse in 30-second steps, making it easy to estimate the duration anywhere.

The local time of mid-eclipse is marked by a series of yellow lines crossing the eclipse path every 5 minutes. Abbreviations for local times are: PDT = Pacific Daylight Time, MDT = Mountain Daylight Time, CDT = Central Daylight Time, EDT = Eastern Daylight Time, EST = Eastern Standard Time, AMT = Amazon Time, and BRT = Brazil Standard Time. Eclipse circumstances on the central line are labeled with the local time of mid-eclipse, duration of annularity (minutes and seconds) and altitude of the Sun.

All maps were produced using Google Maps as the underlying map with overlying eclipse graphics generated using Javascript code. A web page is available for examining any part of the 2023 eclipse path at a range of zoom magnifications. An added benefit of the web page is that it automatically calculates the local circumstances for any point the user chooses. For more information on the interactive 2023 eclipse map:

[www.eclipsewise.com/solar/SEgmap/2001-2100/SE2023Oct14Agmap.html](http://www.eclipsewise.com/solar/SEgmap/2001-2100/SE2023Oct14Agmap.html)

<sup>2</sup> Eclipse magnitude is defined as the fraction of the Sun's diameter occulted by the Moon.

<sup>3</sup> Because of the Mercator map projection, the actual scale on a given map can vary from this value.

# Global Map of the 2023 Annular Eclipse

## Annular Solar Eclipse of 2023 Oct 14

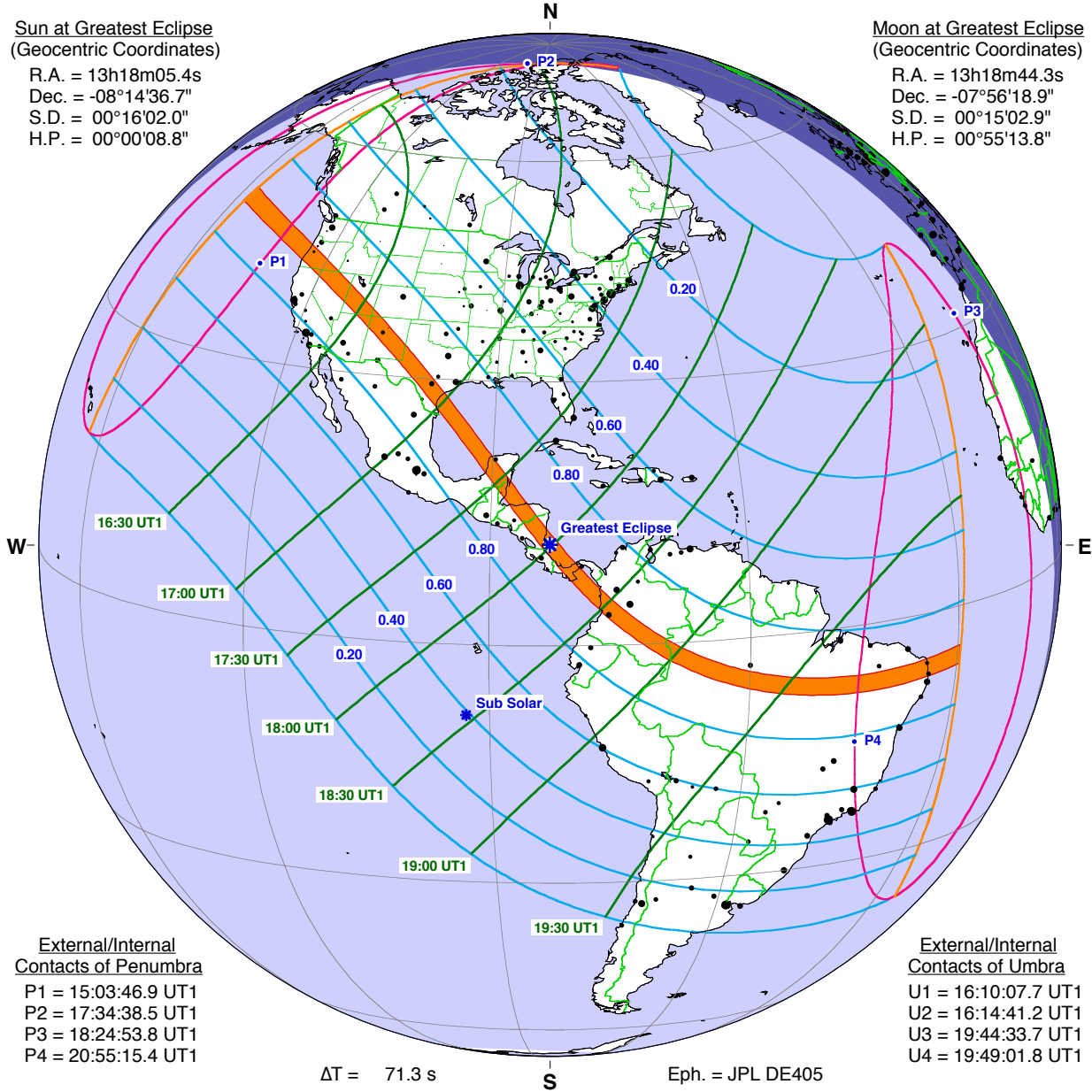
Greatest Eclipse = 18:00:40.6 TD (= 17:59:29.3 UT1)

Eclipse Magnitude = 0.9520  
Gamma = 0.3753

Saros Series = 134  
Saros Member = 44 of 71

Sun at Greatest Eclipse  
(Geocentric Coordinates)  
R.A. = 13h18m05.4s  
Dec. = -08°14'36.7"  
S.D. = 00°16'02.0"  
H.P. = 00°00'08.8"

Moon at Greatest Eclipse  
(Geocentric Coordinates)  
R.A. = 13h18m44.3s  
Dec. = -07°56'18.9"  
S.D. = 00°15'02.9"  
H.P. = 00°55'13.8"



External/Internal  
Contacts of Penumbra  
P1 = 15:03:46.9 UT1  
P2 = 17:34:38.5 UT1  
P3 = 18:24:53.8 UT1  
P4 = 20:55:15.4 UT1

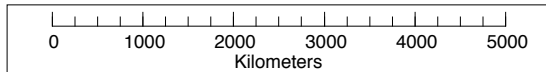
External/Internal  
Contacts of Umbra  
U1 = 16:10:07.7 UT1  
U2 = 16:14:41.2 UT1  
U3 = 19:44:33.7 UT1  
U4 = 19:49:01.8 UT1

Circumstances at Greatest Eclipse: 17:59:29.3 UT1

Lat. = 11°22.1'N      Sun Alt. = 67.9°  
Long. = 083°06.1'W      Sun Azm. = 208.0°  
Path Width = 187.4 km      Duration = 05m17.2s

Circumstances at Greatest Duration: 18:13:09.2 UT1

Lat. = 08°14.6'N      Sun Alt. = 66.8°  
Long. = 080°24.1'W      Sun Azm. = 225.1°  
Path Width = 191.1 km      Duration = 05m17.8s



©2016 F. Espenak  
www.EclipseWise.com

Map courtesy of "21st Century Canon of Solar Eclipses" by Fred Espenak (2017)

## 6 – EclipseWise.com Web Site

For many years the *NASA Eclipse Web Site* was the primary Internet resource for predictions and information on eclipses of the Sun and Moon. *EclipseWise.com* has now superseded the *NASA Eclipse Web Site* with new and improved features.

*EclipseWise.com* has individual web pages, maps and diagrams for every solar and lunar eclipse from 2000 BCE to 3000 CE. This covers to 11,898 solar eclipses and 12,064 lunar eclipses. Much of the design, layout and graphics were inspired by the recent publications *Thousand Year Canon of Solar Eclipses 1501 to 2500* and the *Thousand Year Canon of Lunar Eclipses 1501 to 2500*. (See: [www.astropixels.com/pubs](http://www.astropixels.com/pubs) )

The graphical user interface used by *EclipseWise.com* offers an intuitive way of accessing eclipse predictions. For example, the home page presents a concise preview of all upcoming solar and lunar eclipses over several years. Each small eclipse diagram gives a quick preview of an eclipse and links to a dedicated page for that particular eclipse.

The main or top pages of *EclipseWise.com* are:

Home Page (both solar and lunar eclipses): [www.eclipsewise.com/eclipse.html](http://www.eclipsewise.com/eclipse.html)

Solar Eclipses Page: [www.eclipsewise.com/solar/solar.html](http://www.eclipsewise.com/solar/solar.html)

Lunar Eclipses Page: [www.eclipsewise.com/lunar/lunar.html](http://www.eclipsewise.com/lunar/lunar.html)

## 7 – EclipseWise.com and the 2023 Annular Eclipse

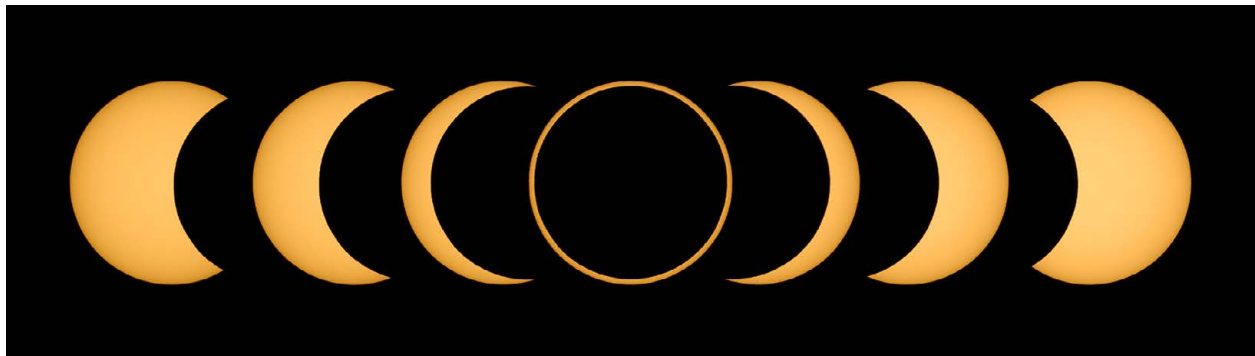
*EclipseWise.com* has a series of pages and resources devoted to the 2023 eclipse. The main page is located at:

[www.eclipsewise.com/solar/SEprime/2001-2100/SE2023Oct14Aprime.html](http://www.eclipsewise.com/solar/SEprime/2001-2100/SE2023Oct14Aprime.html)

It provides links to detailed eclipse path maps, tables of eclipse path coordinates, Besselian elements, and more. The link to an interactive Google Map with the eclipse path plotted allows the user to zoom into a part of the path. Click on any point on the map to display the eclipse circumstances and duration of annularity at that location. This web site will continue to add features as the eclipse approaches.

The *2023 Annular Solar Eclipse Circumstances Calculator* is an interactive web page that can quickly calculate the local circumstances for the eclipse from any geographic location. The *Calculator* is located at:

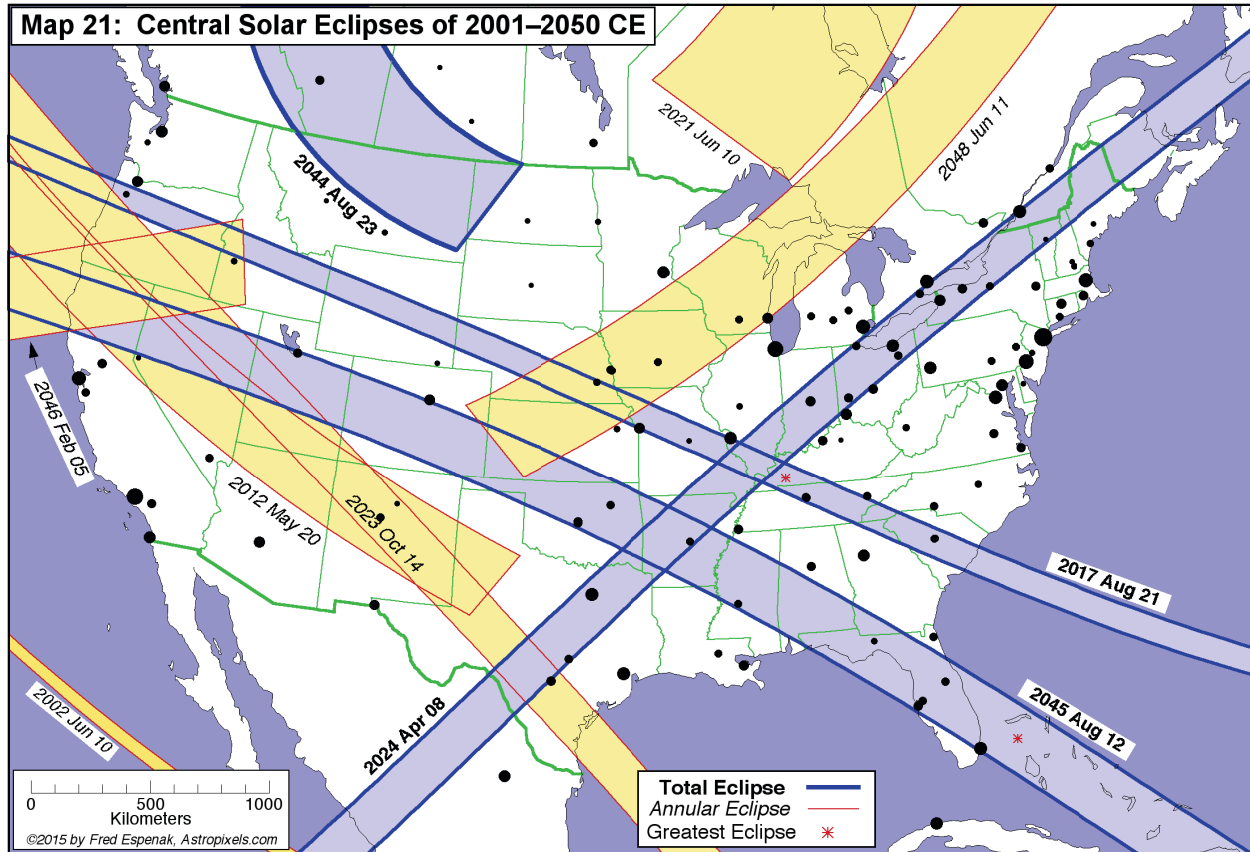
[www.EclipseWise.com/solar/SEcirc/2001-2100/SE2023Oct14Acirc.html](http://www.EclipseWise.com/solar/SEcirc/2001-2100/SE2023Oct14Acirc.html)



An entire annular eclipse is captured in the above composite of seven separate images. This sequence was captured during the annular solar eclipse of October 3, 2005 from Carrascosa del Campo, Spain.  
© 2005 F. Espenak, [www.MrEclipse.com](http://www.MrEclipse.com)

## 8 – Total and Annular Eclipses in the USA and Canada: 2001 – 2050

During the first 50 years of the 21<sup>st</sup> Century, the paths of four total and five annular solar eclipses pass through parts of the USA and Canada. The following map illustrates exactly where each of these rare celestial events will be visible from. The blue shaded paths are total eclipses, while the yellow shaded paths are annular eclipses.



Map courtesy of "Atlas of Central Solar Eclipses in the USA" by Fred Espenak (2017).

The dates of these central eclipses are listed in the following table.

### Total Eclipses of the Sun

- 1) 2017 August 17
- 2) 2024 April 08
- 3) 2044 August 23
- 4) 2045 August 12

### Annular Eclipses of the Sun

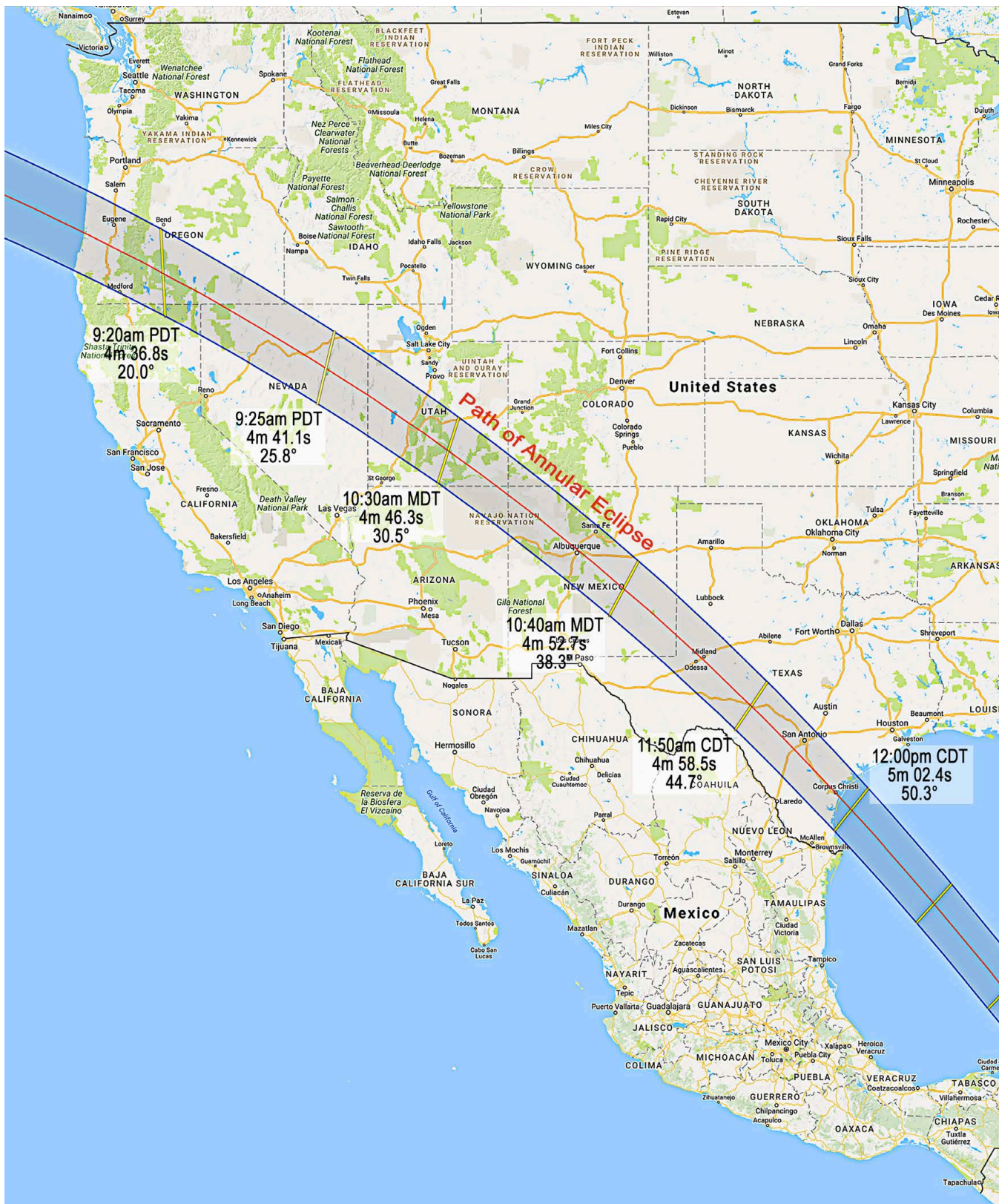
- 1) 2012 May 20
- 2) 2021 June 10 (Canada only)
- 3) 2023 October 14
- 4) 2046 February 05
- 5) 2048 June 11

For more information on central eclipses in the USA, see: [www.eclipsewise.com/solar/SEcountry/SEinUSA.html](http://www.eclipsewise.com/solar/SEcountry/SEinUSA.html)

## 9 – Eclipse Predictions

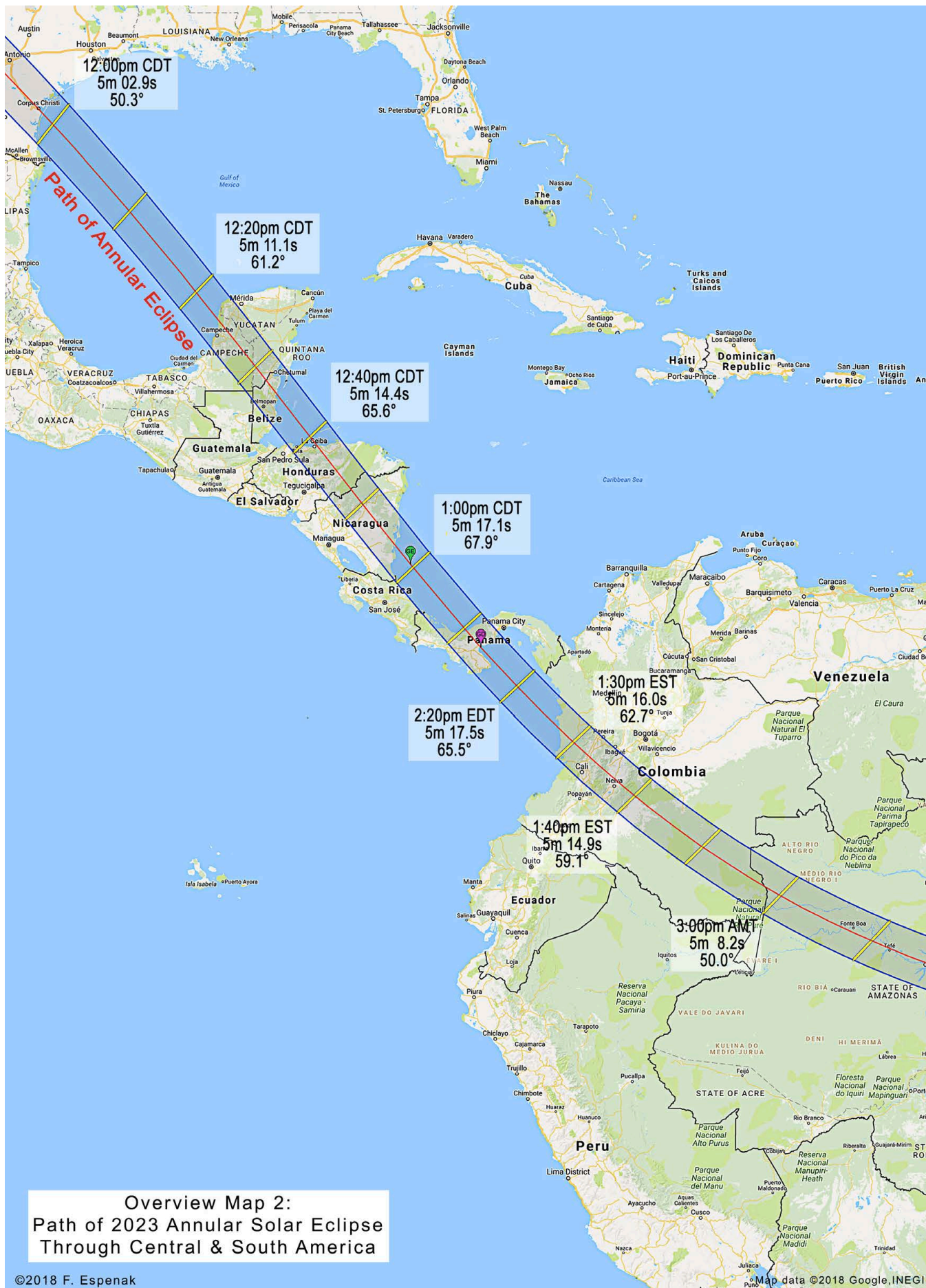
The algorithms and software for the eclipse predictions were developed primarily from the *Explanatory Supplement to the Astronomical Ephemeris* (Her Majesty's Nautical Almanac Office, 1974) with additional algorithms from *Elements of Solar Eclipses: 1951–2200* (Meeus, 1989). The solar and lunar ephemerides were generated from the JPL DE405. All eclipse calculations were made using a value for the Moon's radius of  $k=0.2722810$  for the path of annularity. Center of mass coordinates for the Moon have been used without correction to the lunar limb profile. A value for  $\Delta T$  of 71.3 seconds was used to convert the predictions from Terrestrial Dynamical Time to Universal Time (UT1).

# ROAD ATLAS FOR THE 2023 ANNULAR SOLAR ECLIPSE



Overview Map 1:  
Path of 2023 Annular Solar Eclipse  
Through Western USA

# ROAD ATLAS FOR THE 2023 ANNULAR SOLAR ECLIPSE

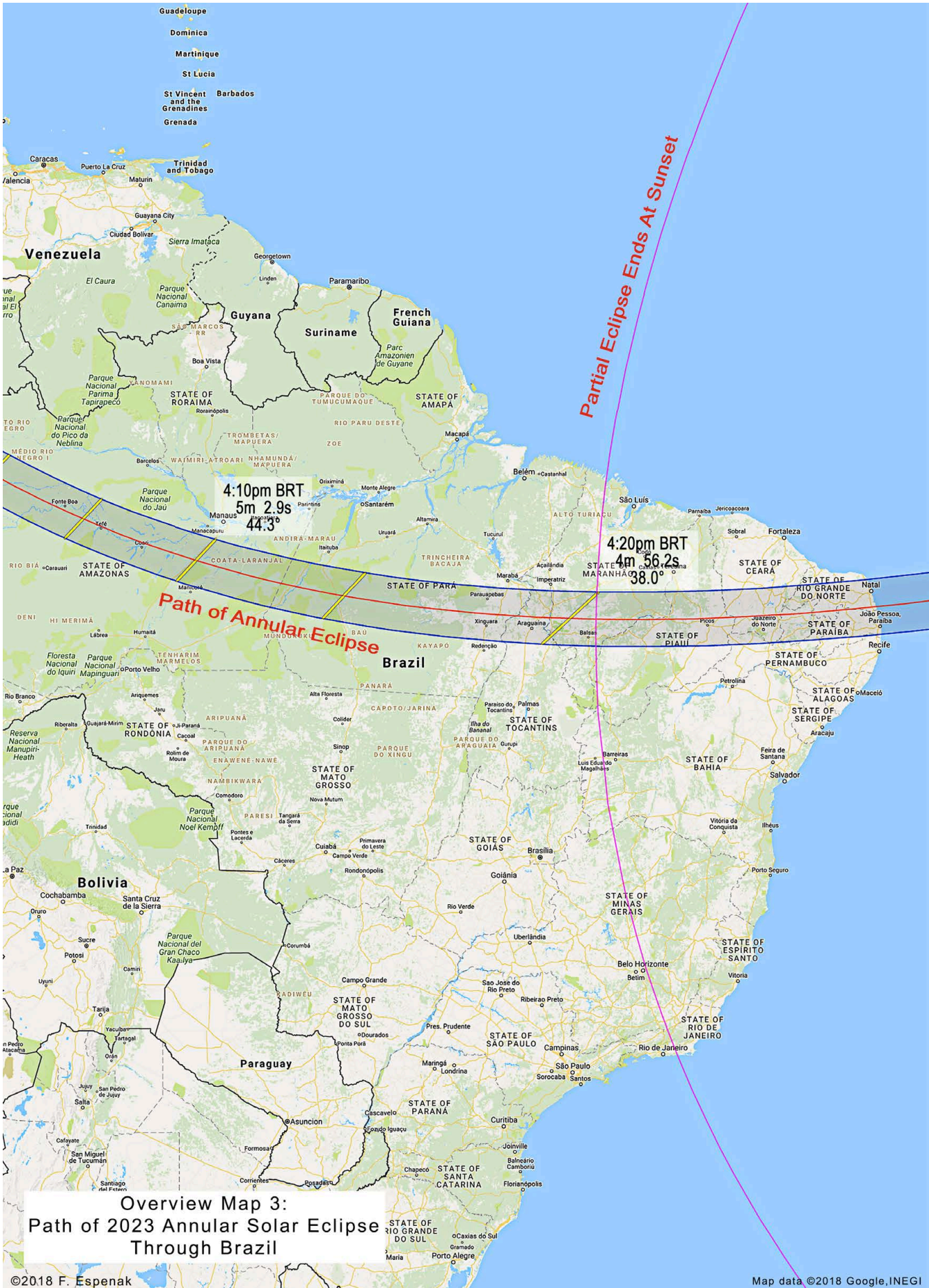


©2018 F. Espenak

Map data ©2018 Google, INEGI



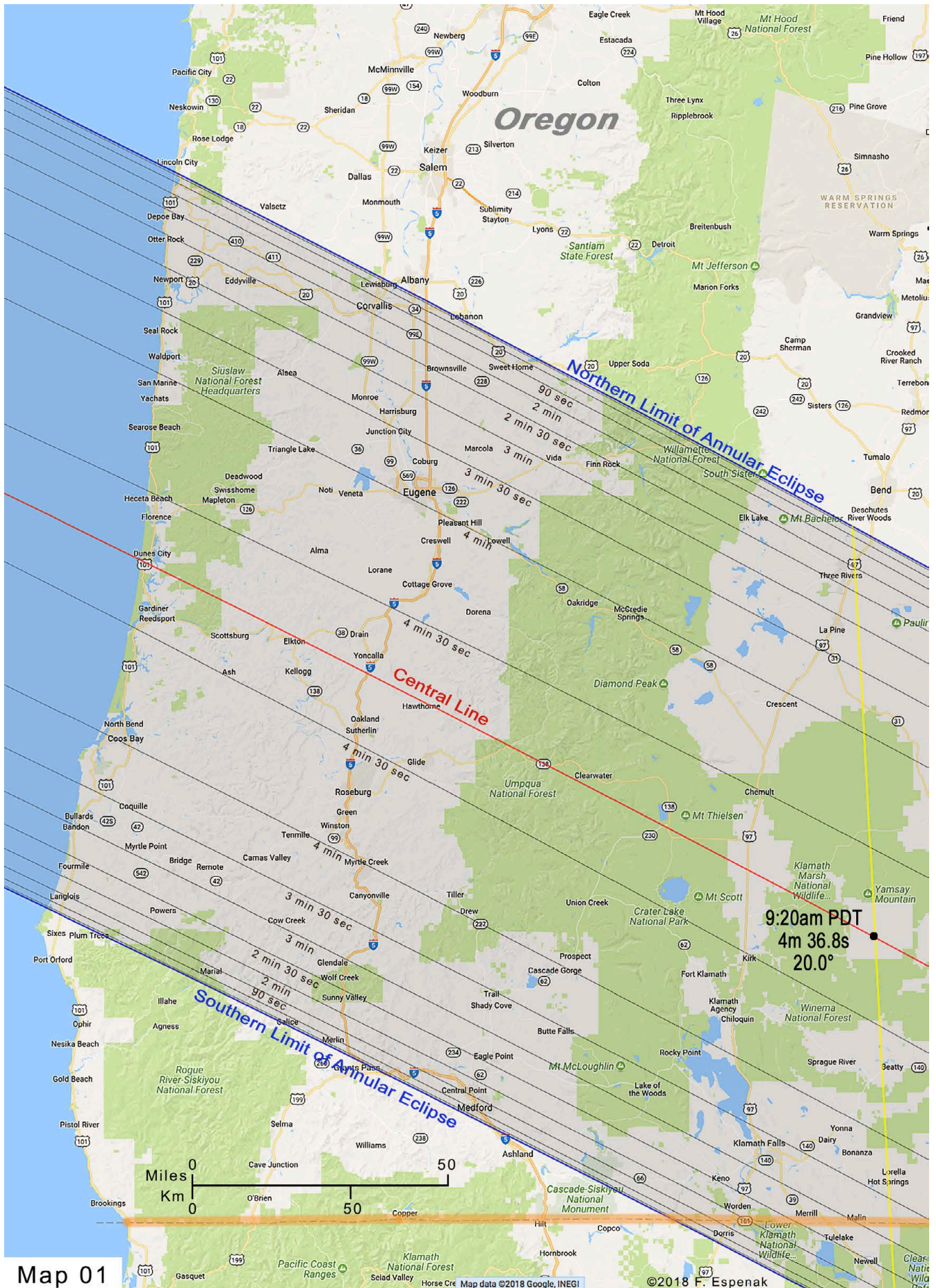
ROAD ATLAS FOR THE 2023 ANNULAR SOLAR ECLIPSE



©2018 F. Espenak

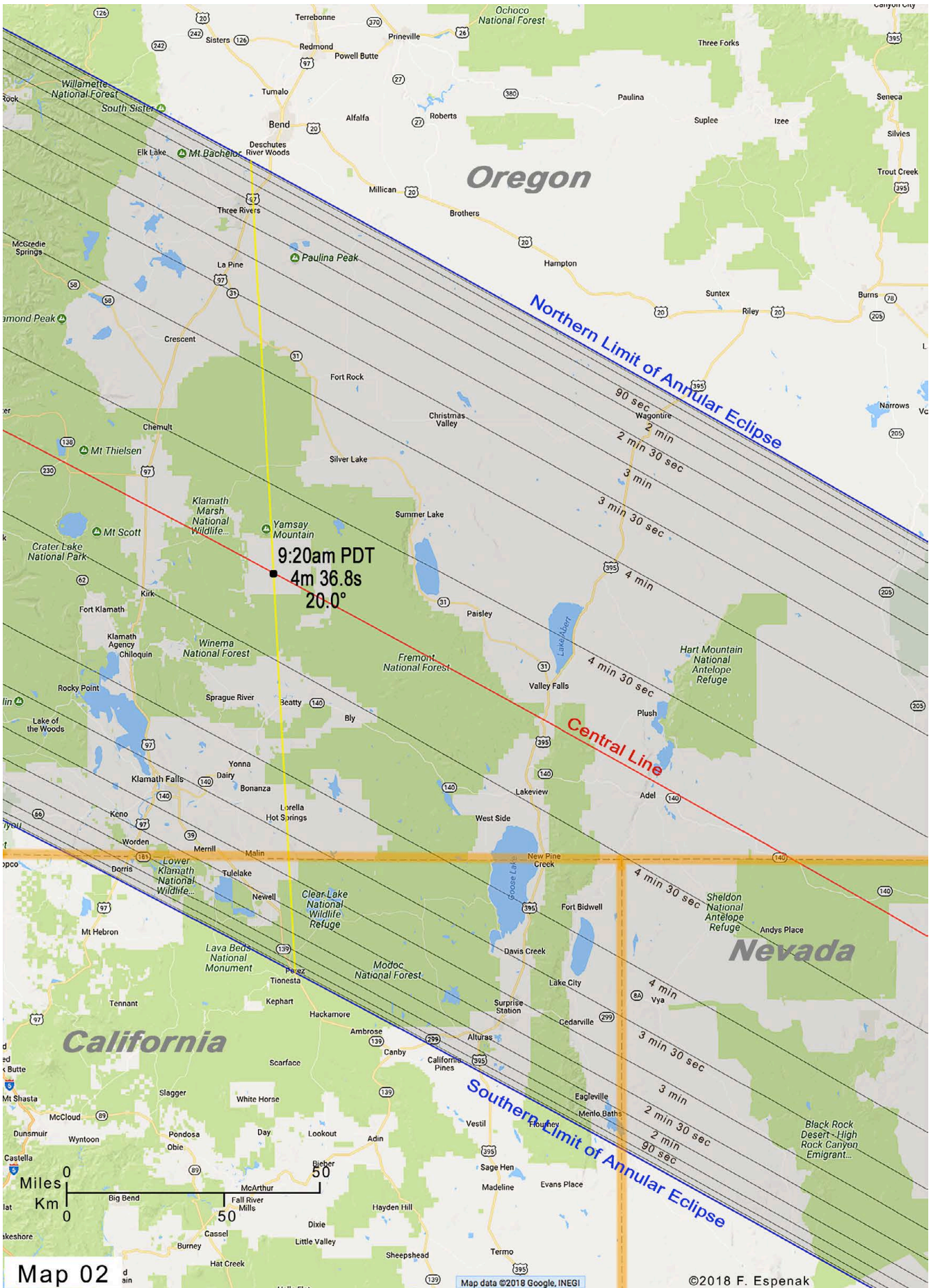
Map data ©2018 Google, INEGI

# ROAD ATLAS FOR THE 2023 ANNULAR SOLAR ECLIPSE

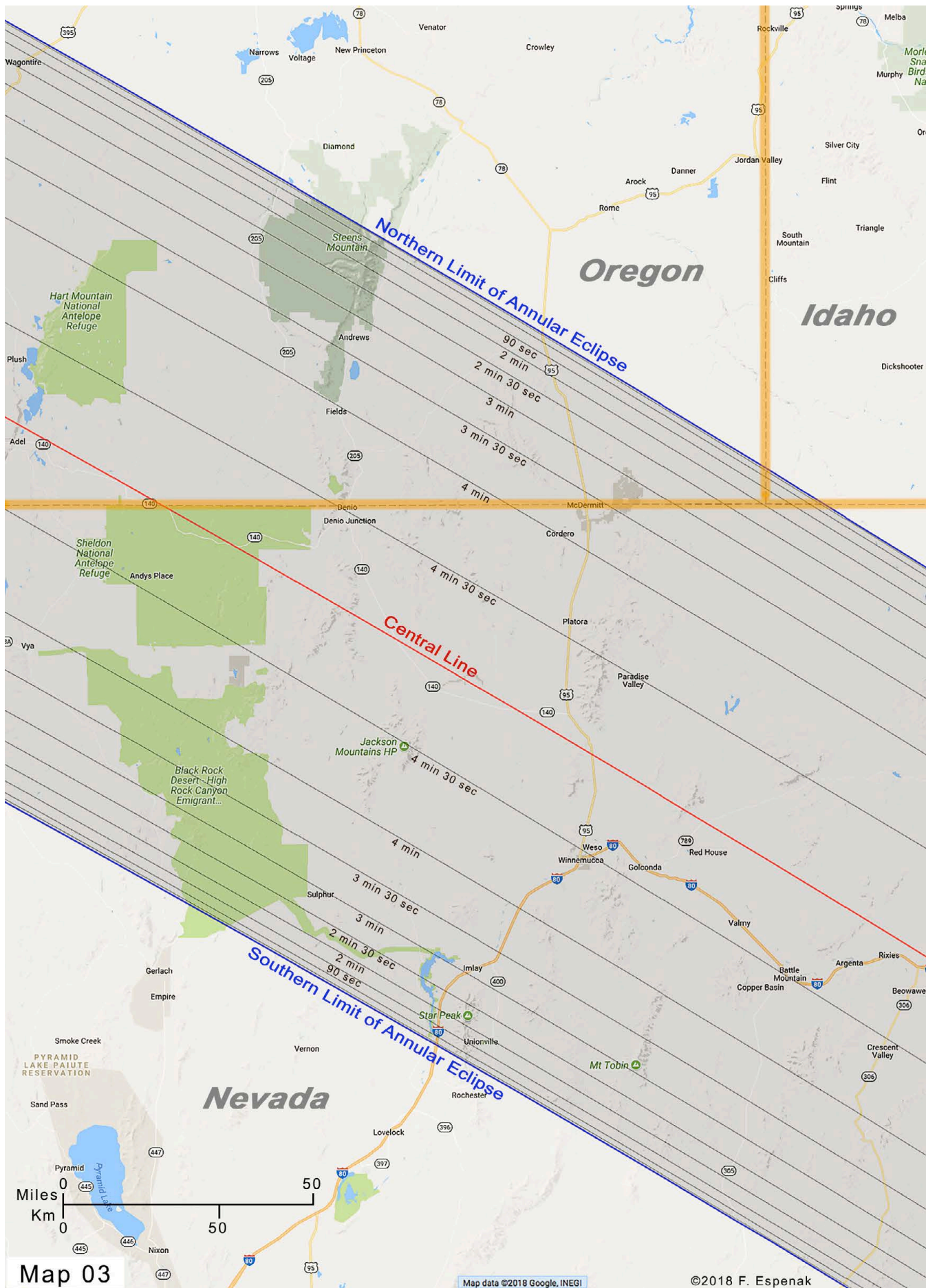


Map 01

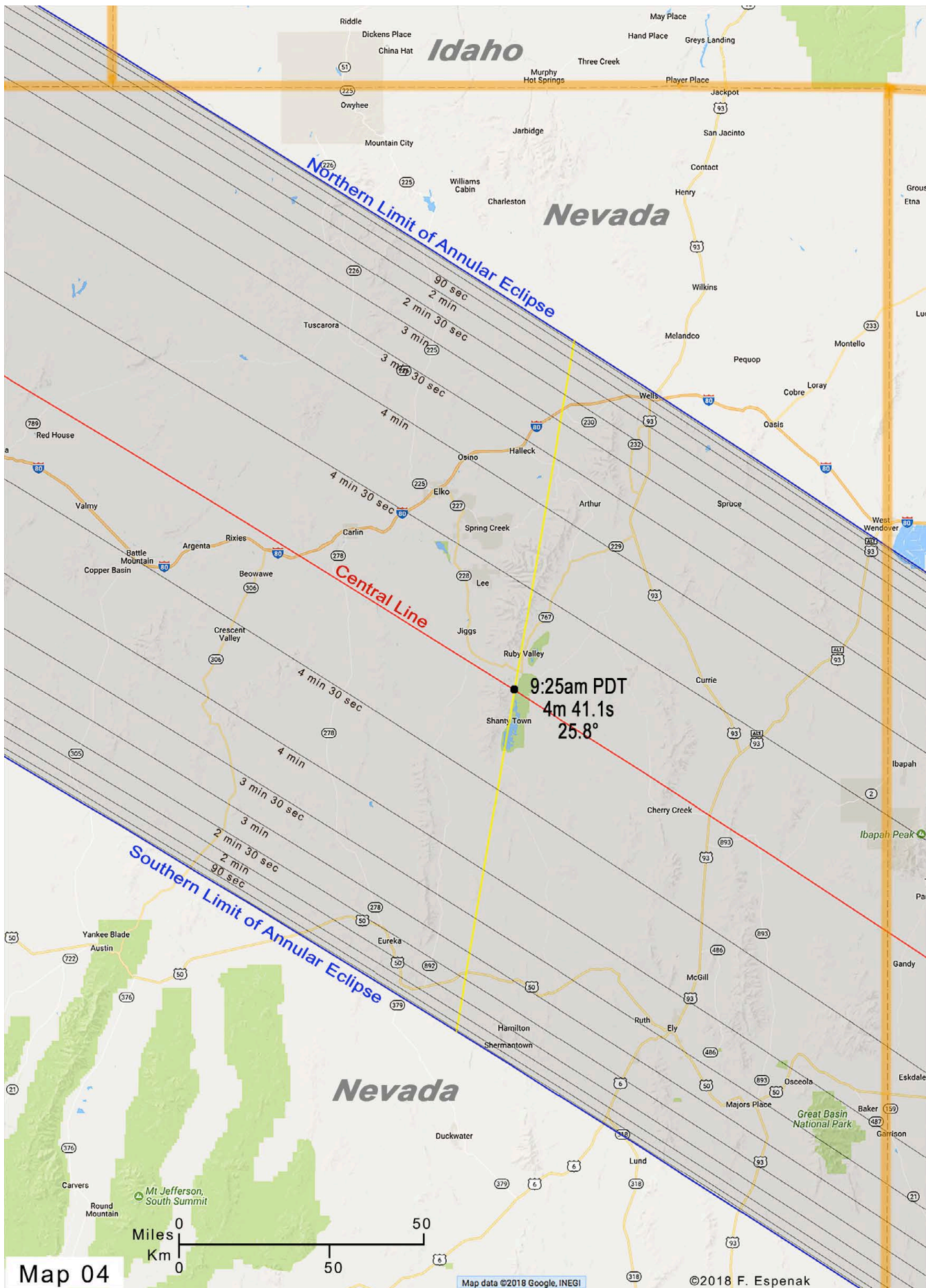
ROAD ATLAS FOR THE 2023 ANNULAR SOLAR ECLIPSE



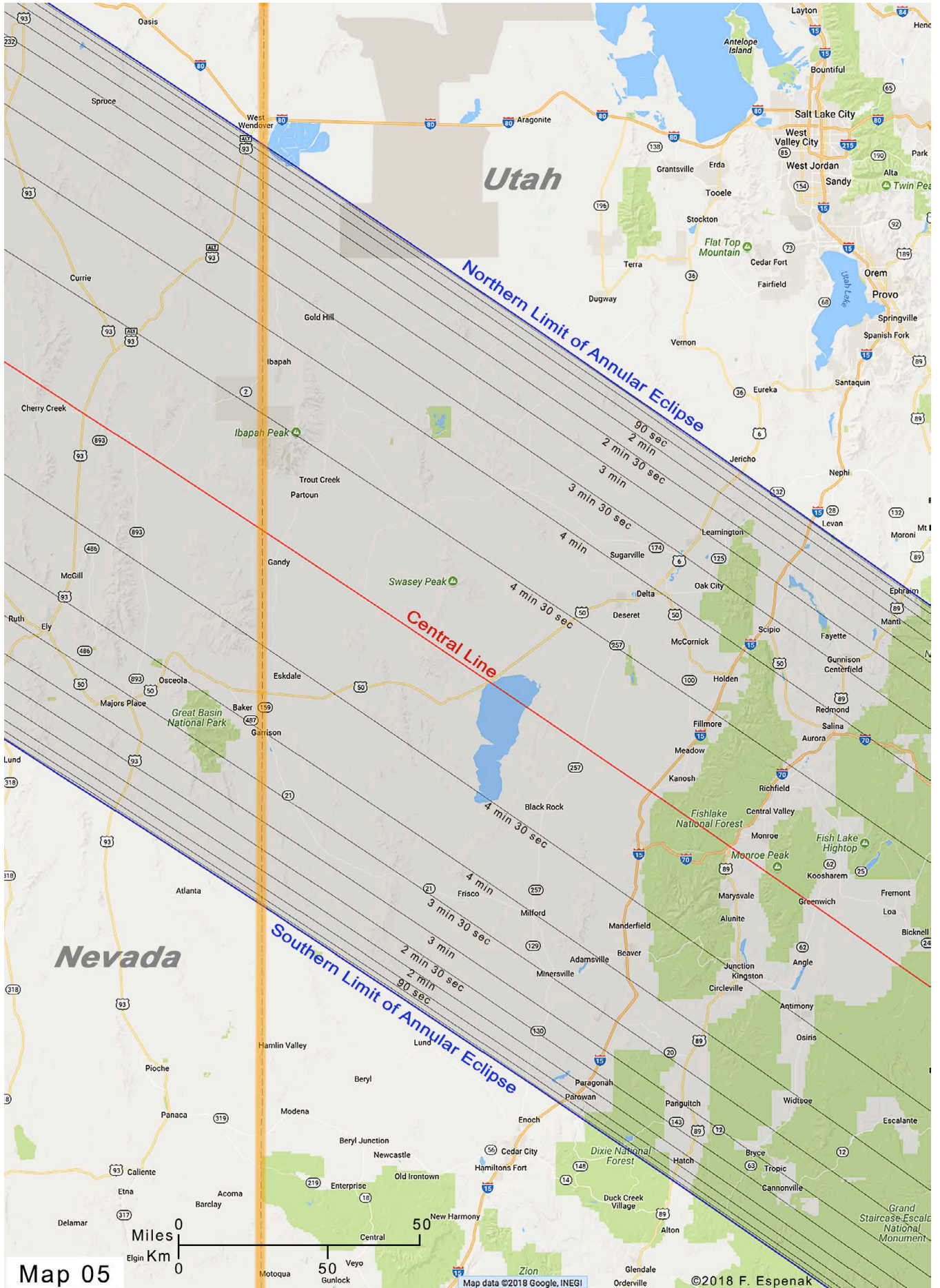
ROAD ATLAS FOR THE 2023 ANNULAR SOLAR ECLIPSE



ROAD ATLAS FOR THE 2023 ANNULAR SOLAR ECLIPSE



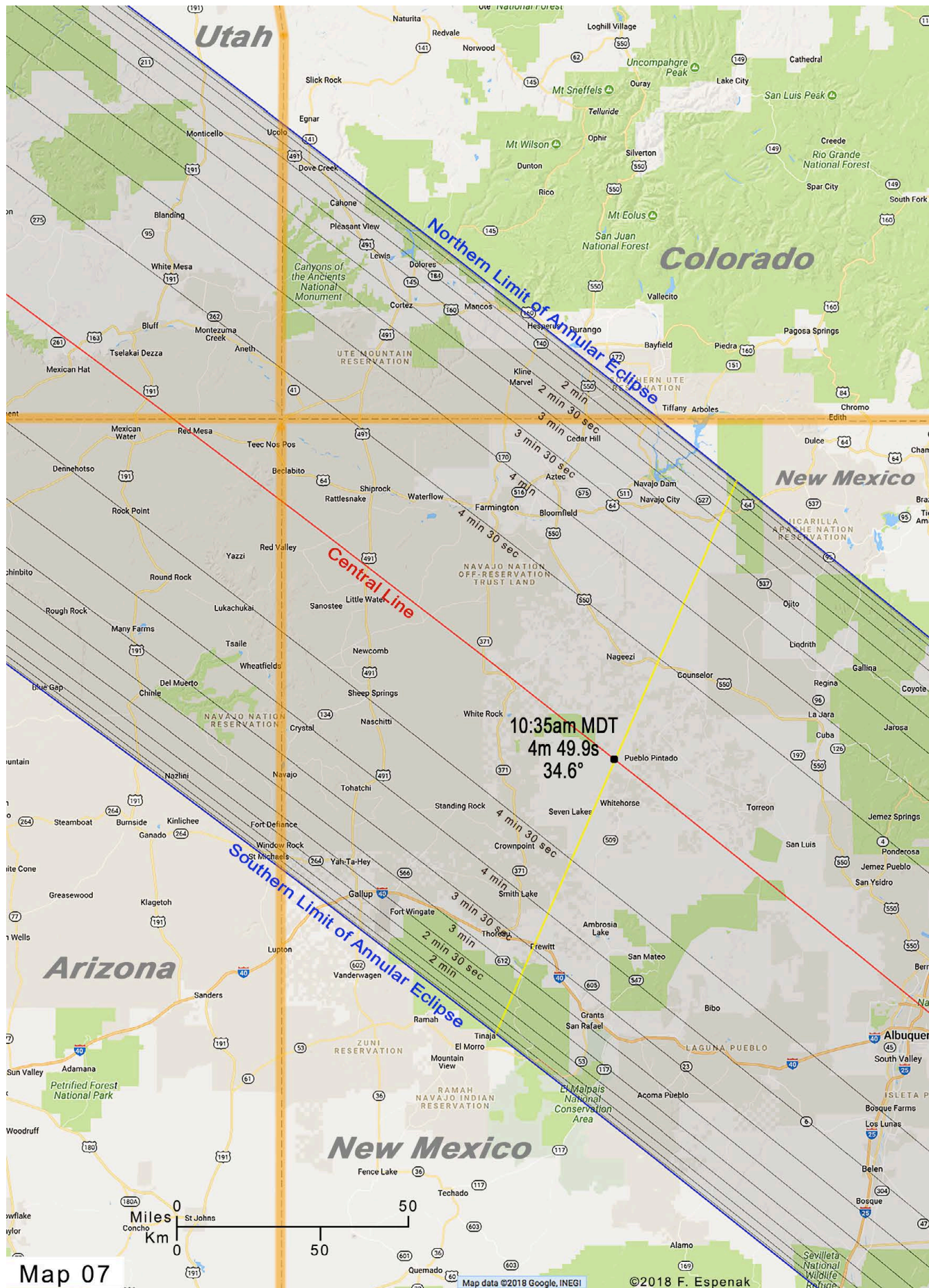
ROAD ATLAS FOR THE 2023 ANNULAR SOLAR ECLIPSE



ROAD ATLAS FOR THE 2023 ANNULAR SOLAR ECLIPSE



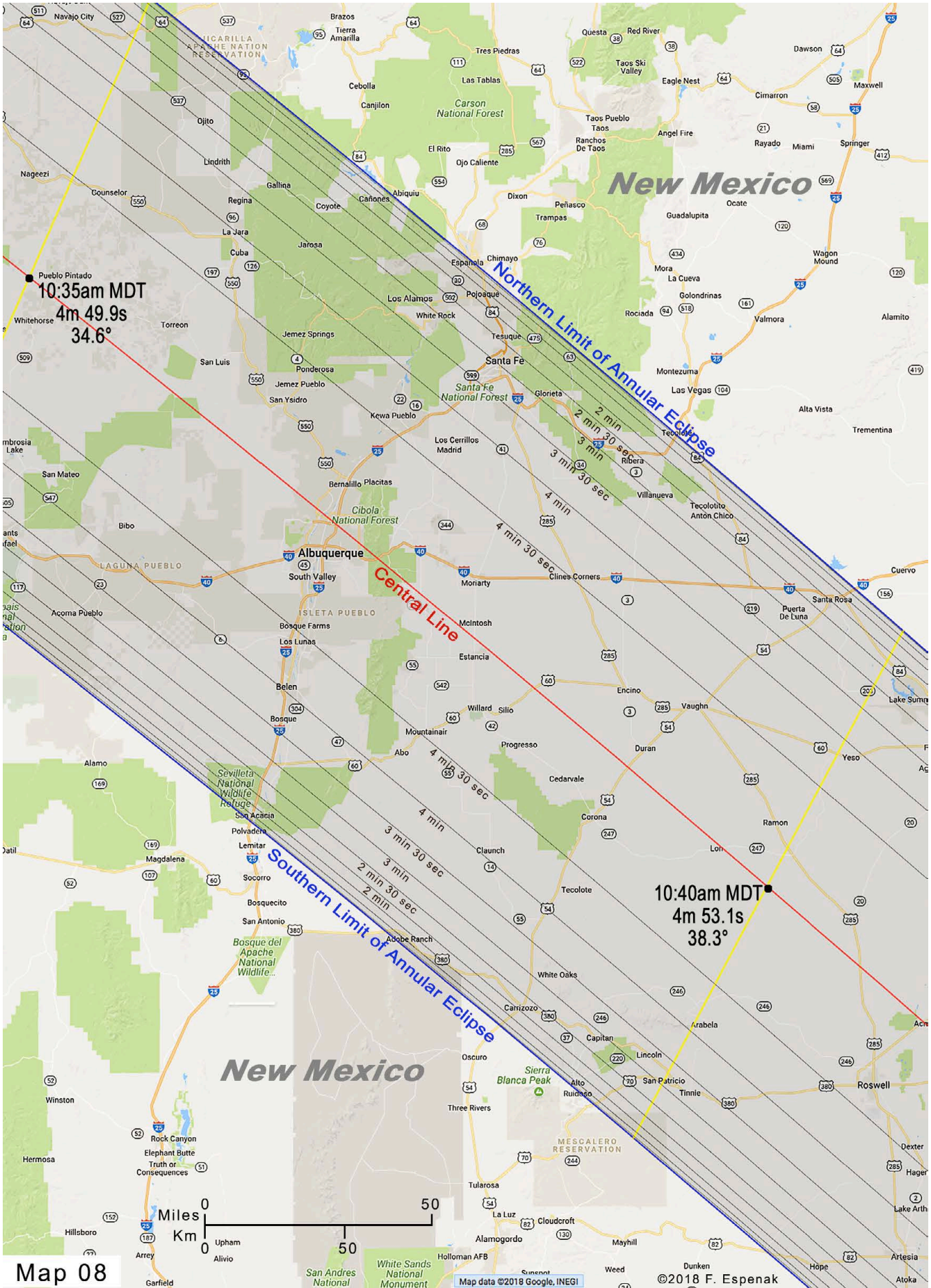
ROAD ATLAS FOR THE 2023 ANNULAR SOLAR ECLIPSE



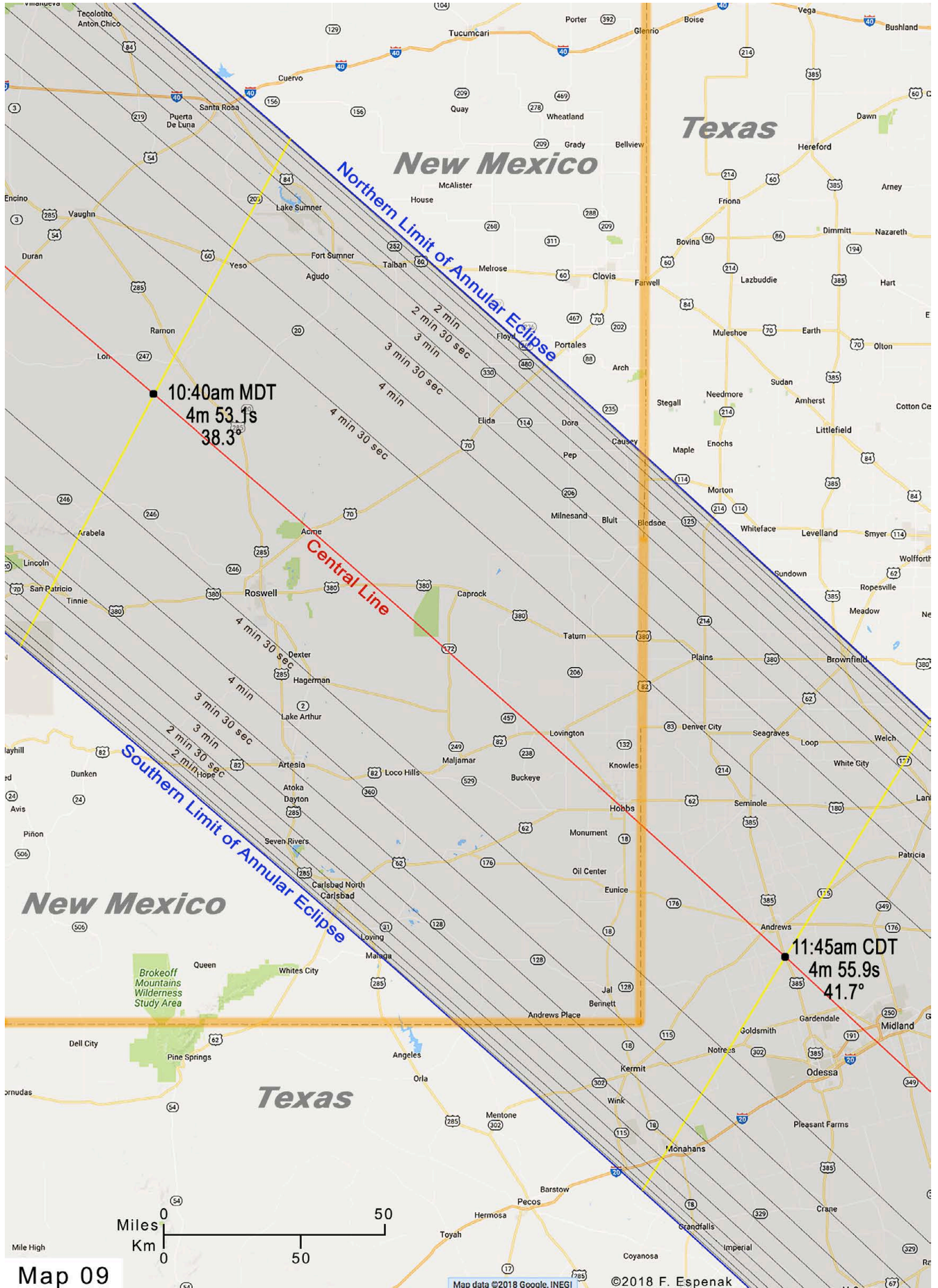
Map 07



ROAD ATLAS FOR THE 2023 ANNULAR SOLAR ECLIPSE



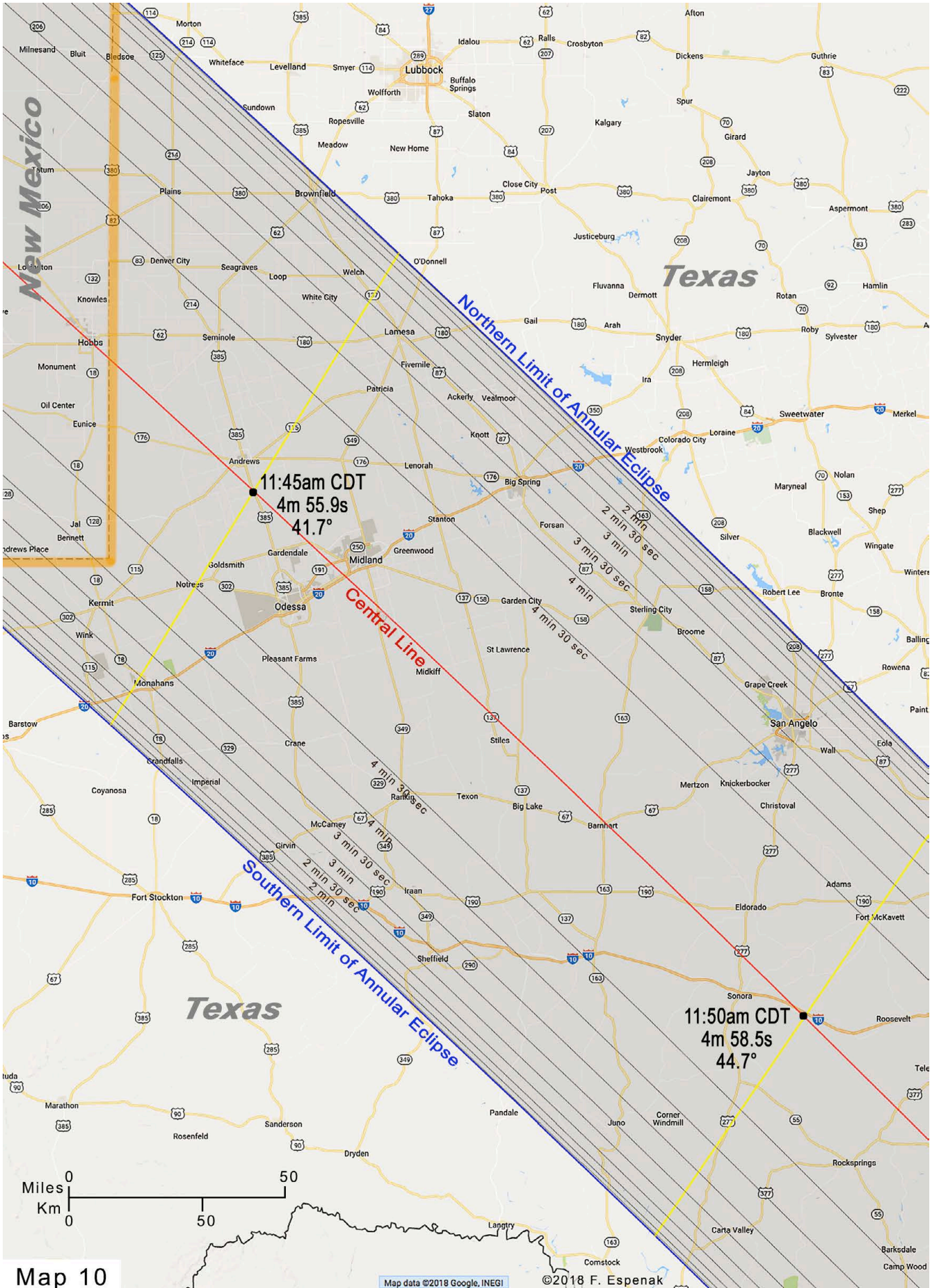
ROAD ATLAS FOR THE 2023 ANNULAR SOLAR ECLIPSE



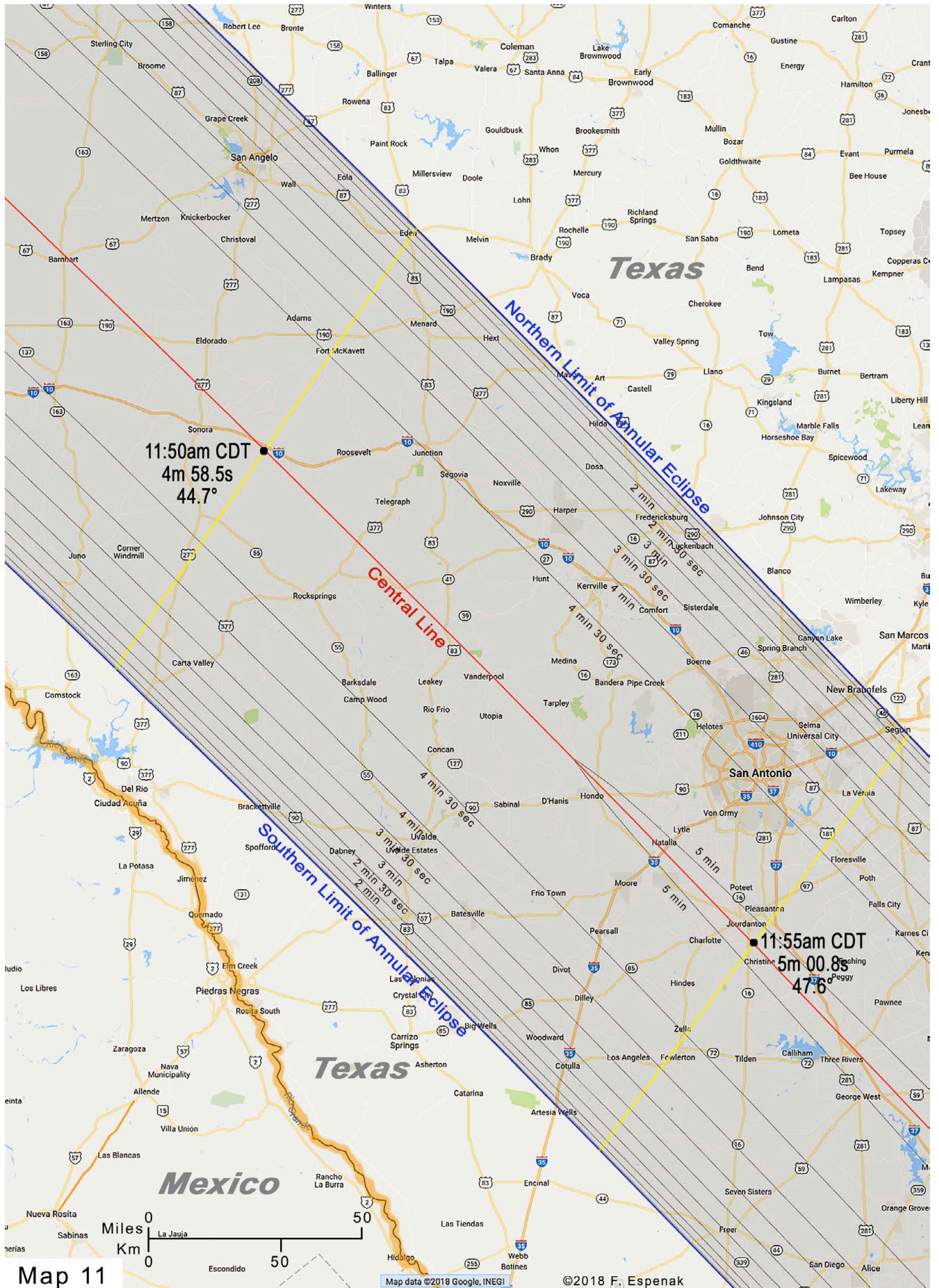
Map 09

Map data ©2018 Google, INEGI ©2018 F. Espenak

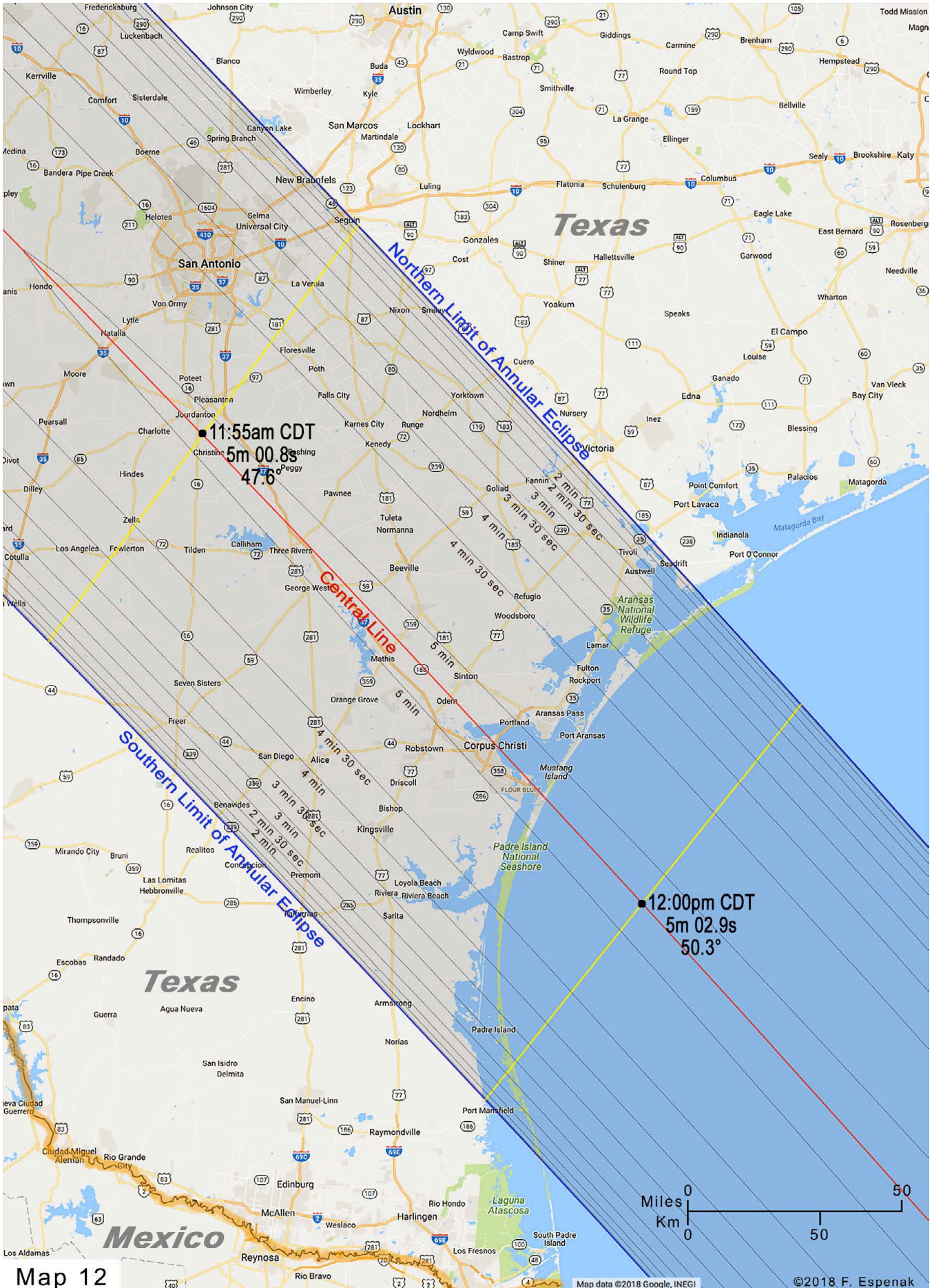
ROAD ATLAS FOR THE 2023 ANNULAR SOLAR ECLIPSE



ROAD ATLAS FOR THE 2023 ANNULAR SOLAR ECLIPSE

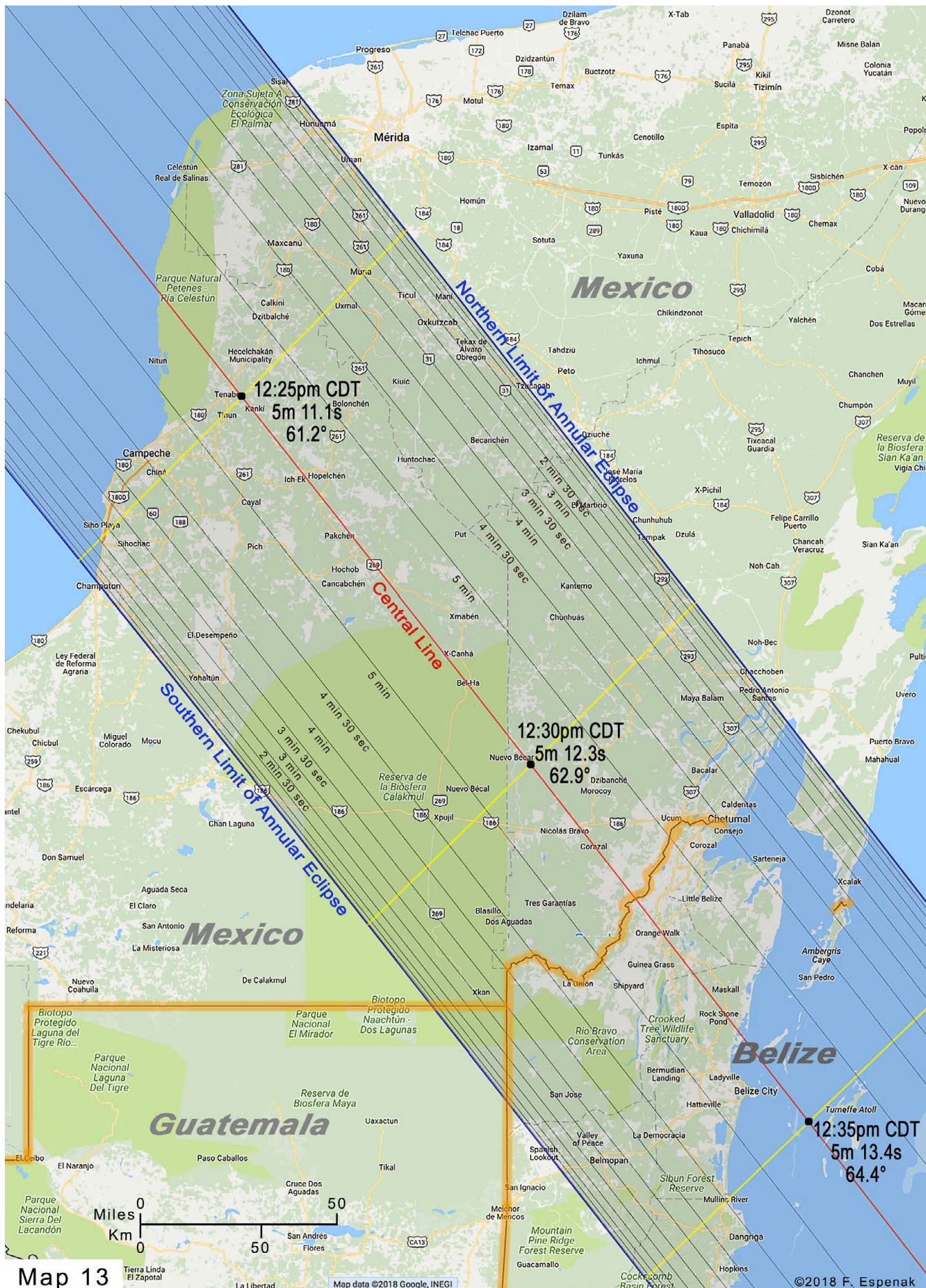


ROAD ATLAS FOR THE 2023 ANNULAR SOLAR ECLIPSE

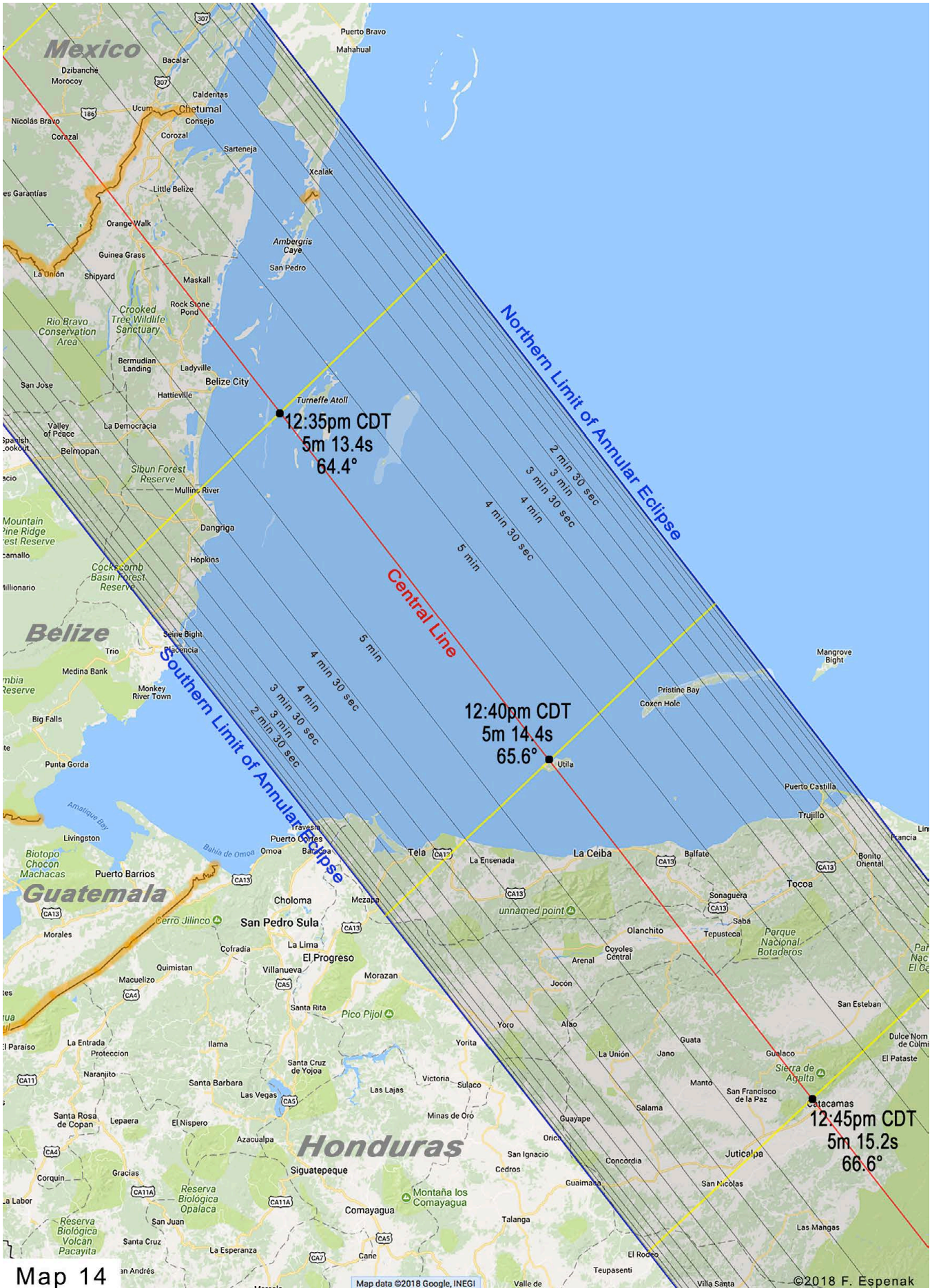


Map 12

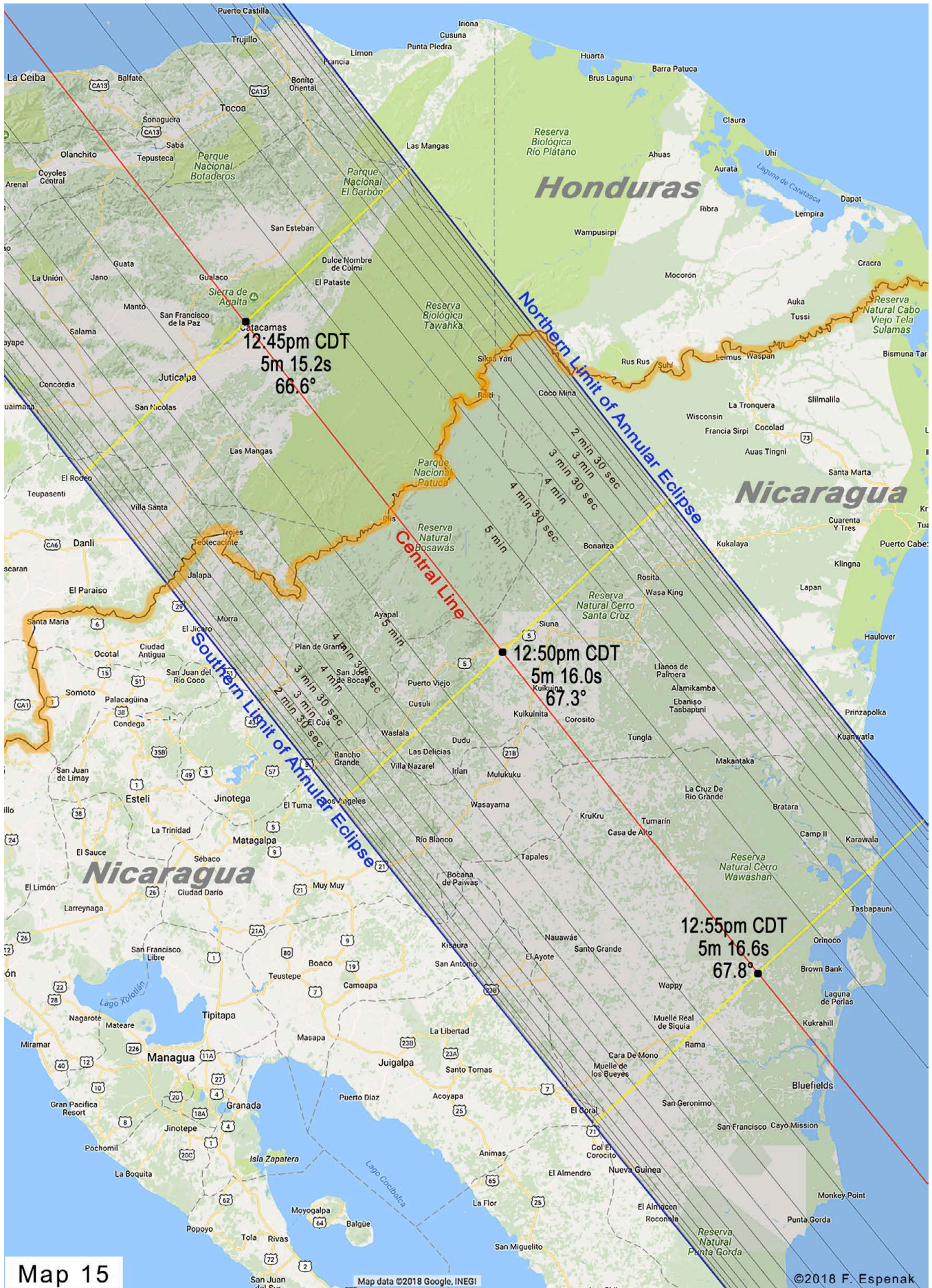
ROAD ATLAS FOR THE 2023 ANNULAR SOLAR ECLIPSE



ROAD ATLAS FOR THE 2023 ANNULAR SOLAR ECLIPSE

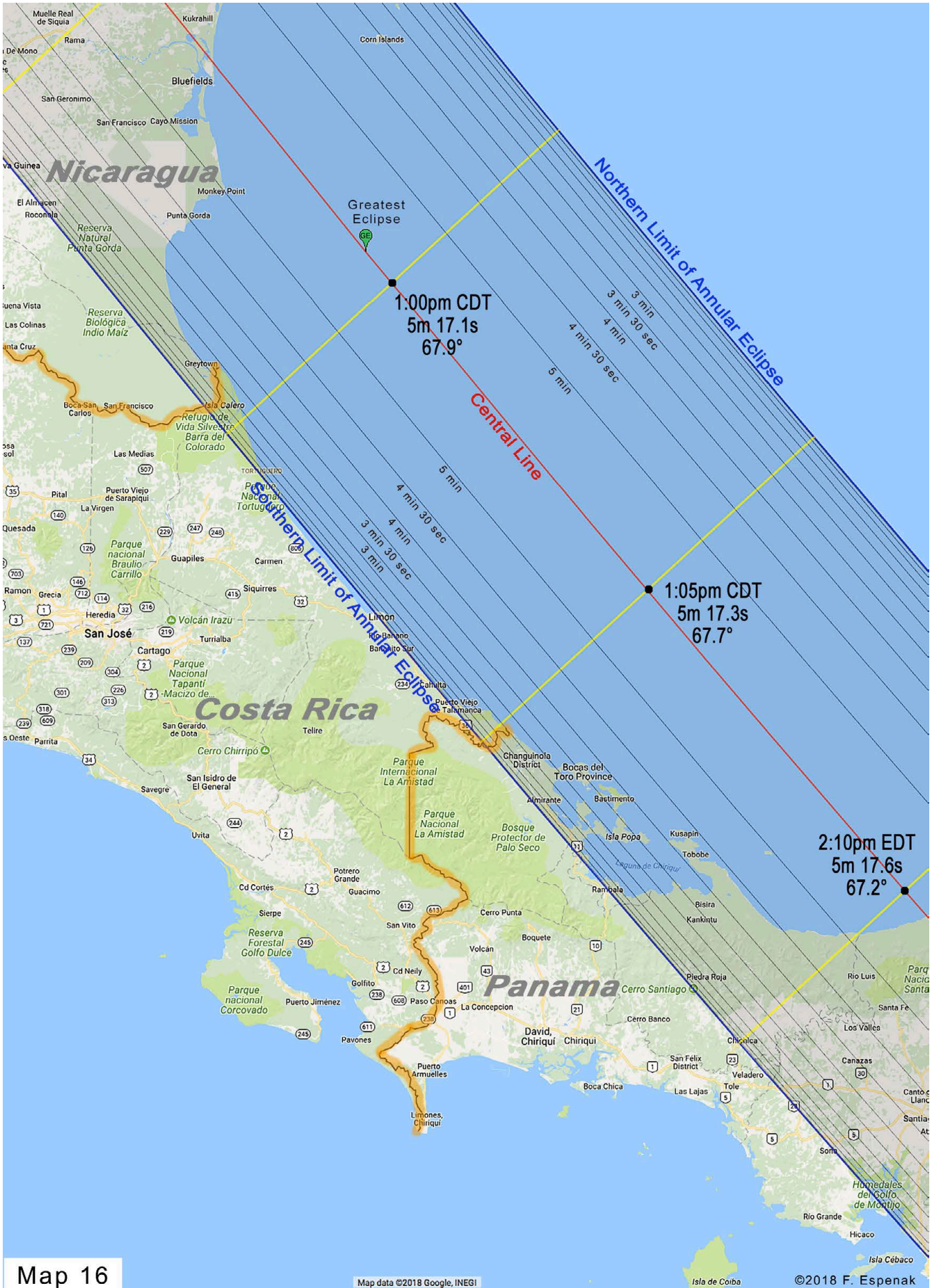


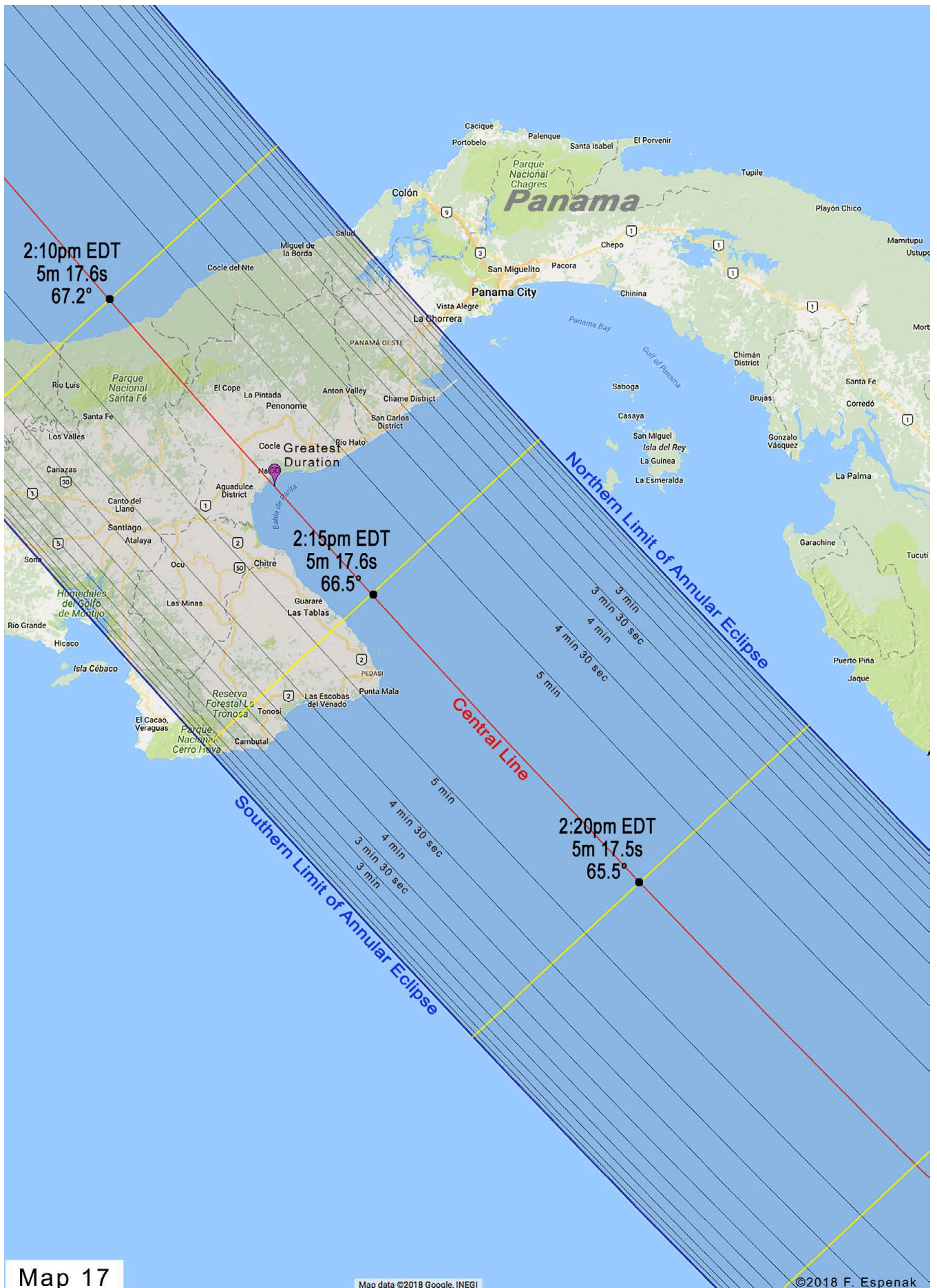
ROAD ATLAS FOR THE 2023 ANNULAR SOLAR ECLIPSE

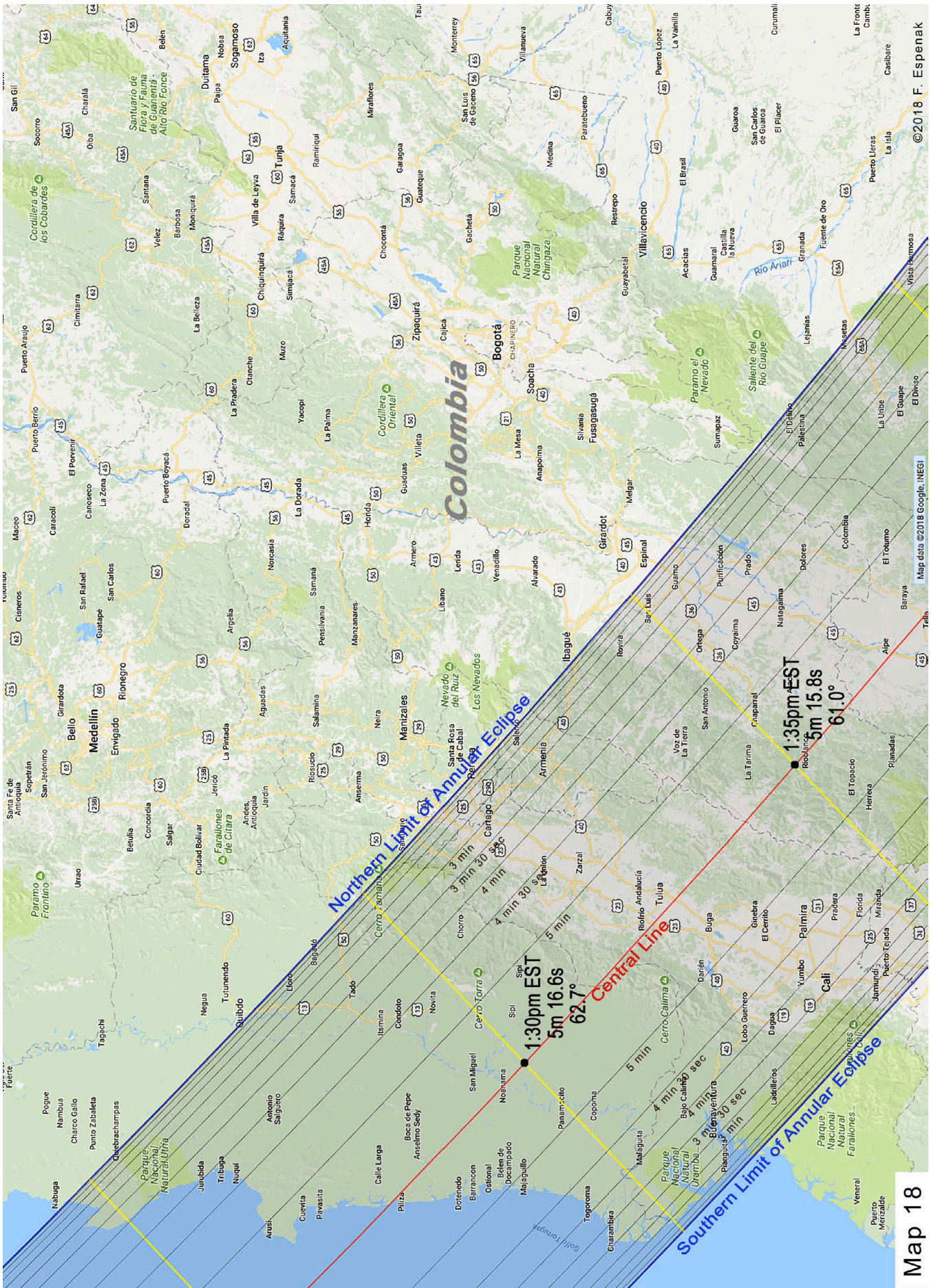




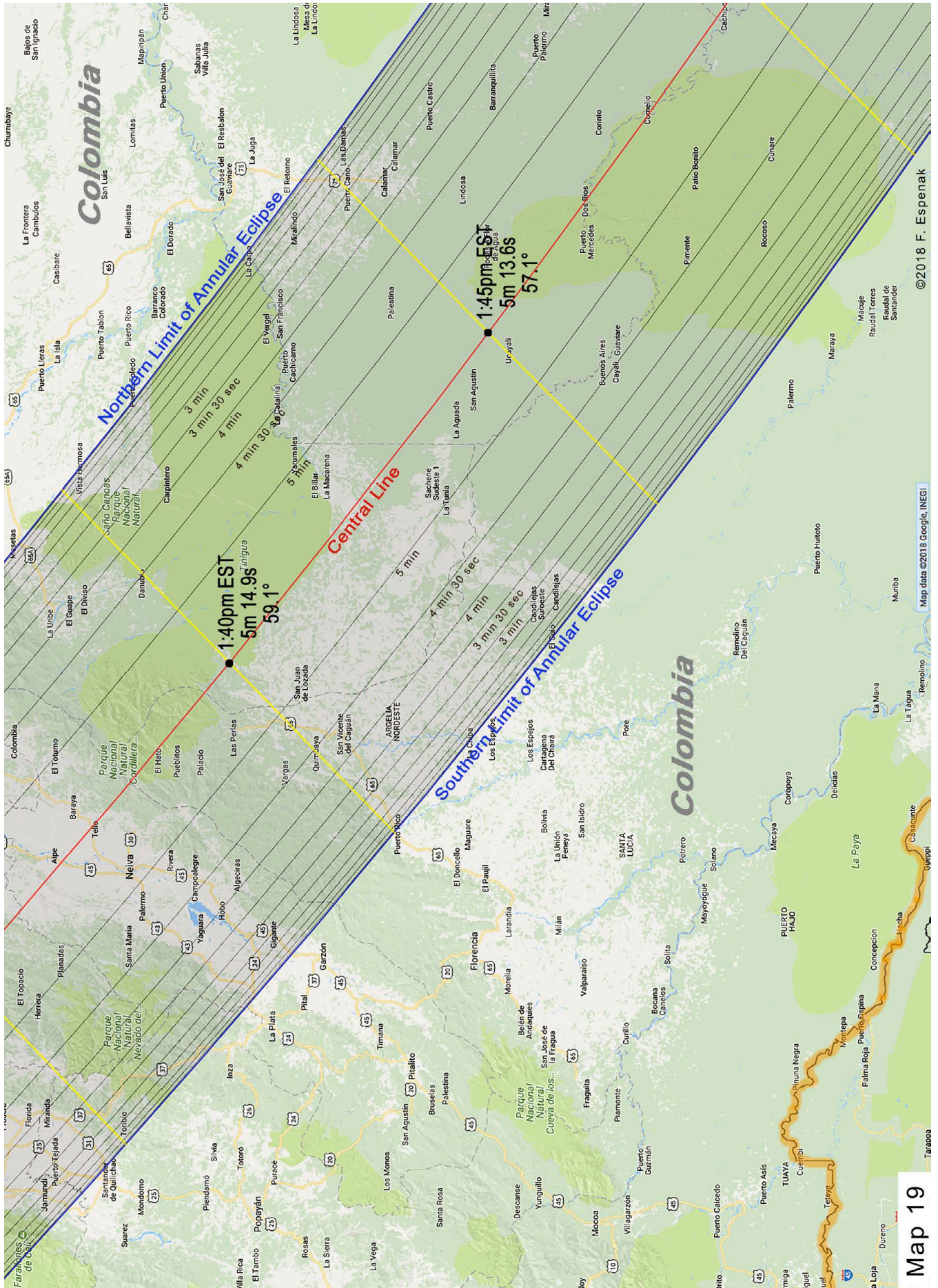
ROAD ATLAS FOR THE 2023 ANNULAR SOLAR ECLIPSE



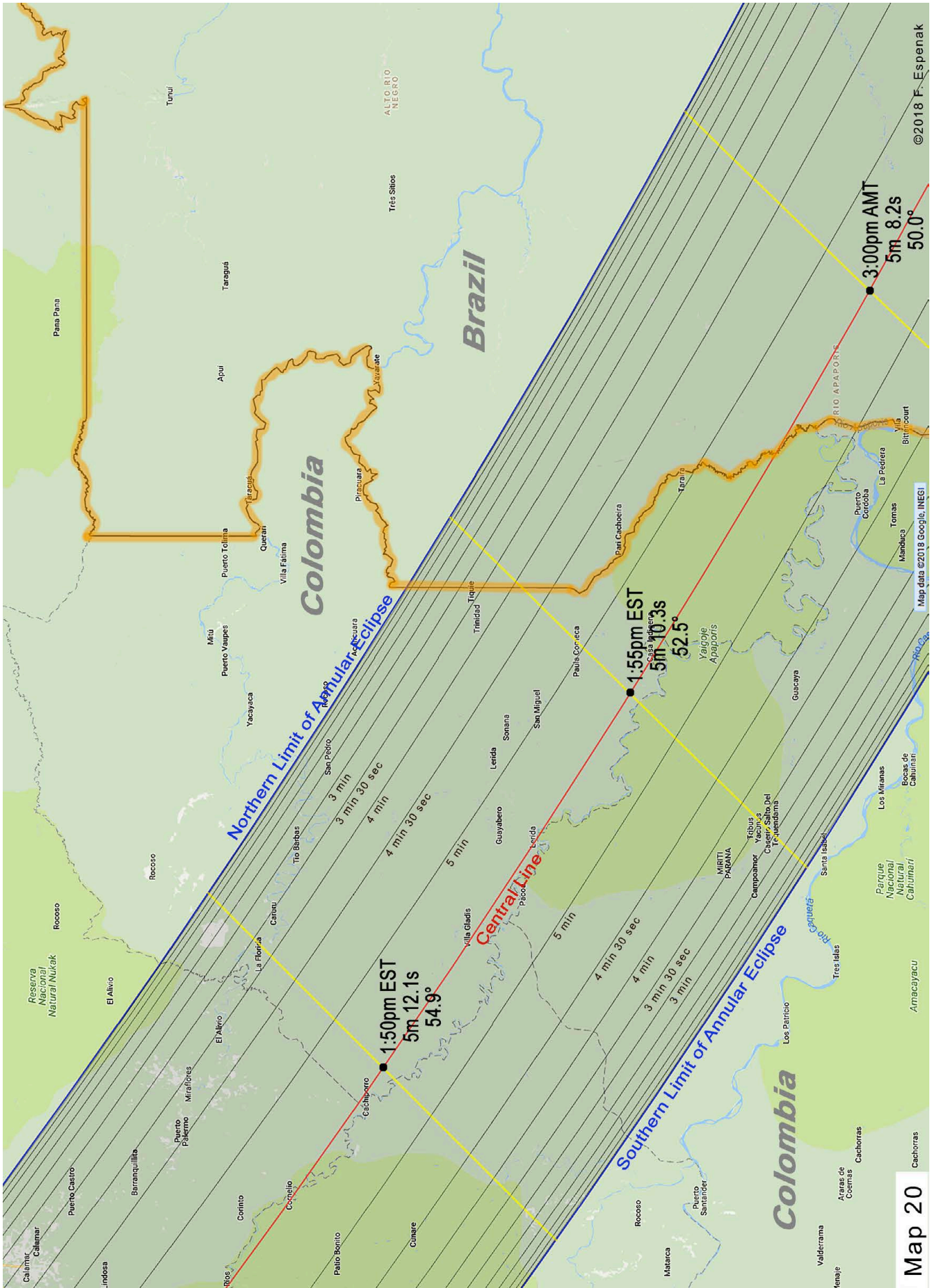


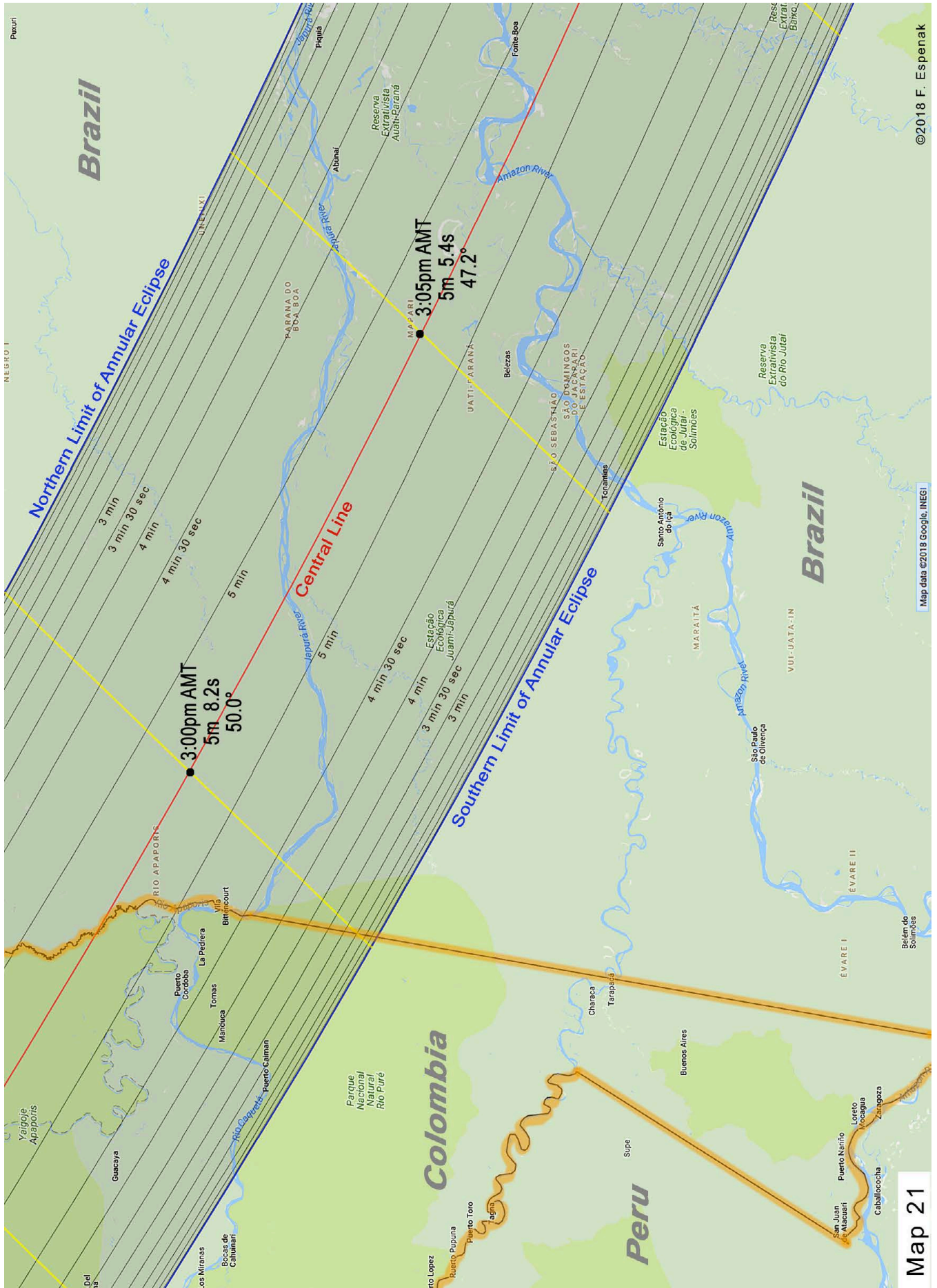


Map 18

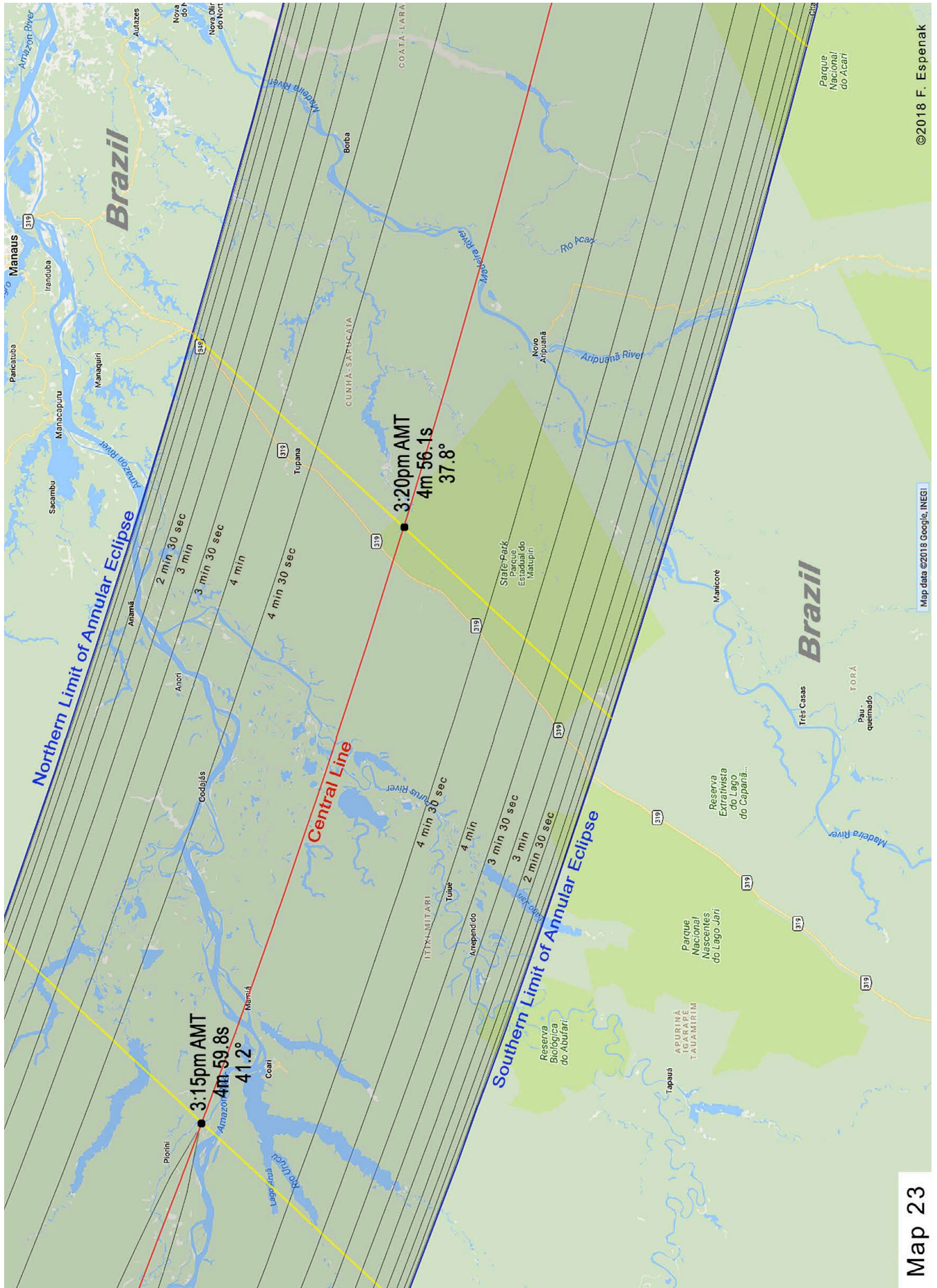


Map 19



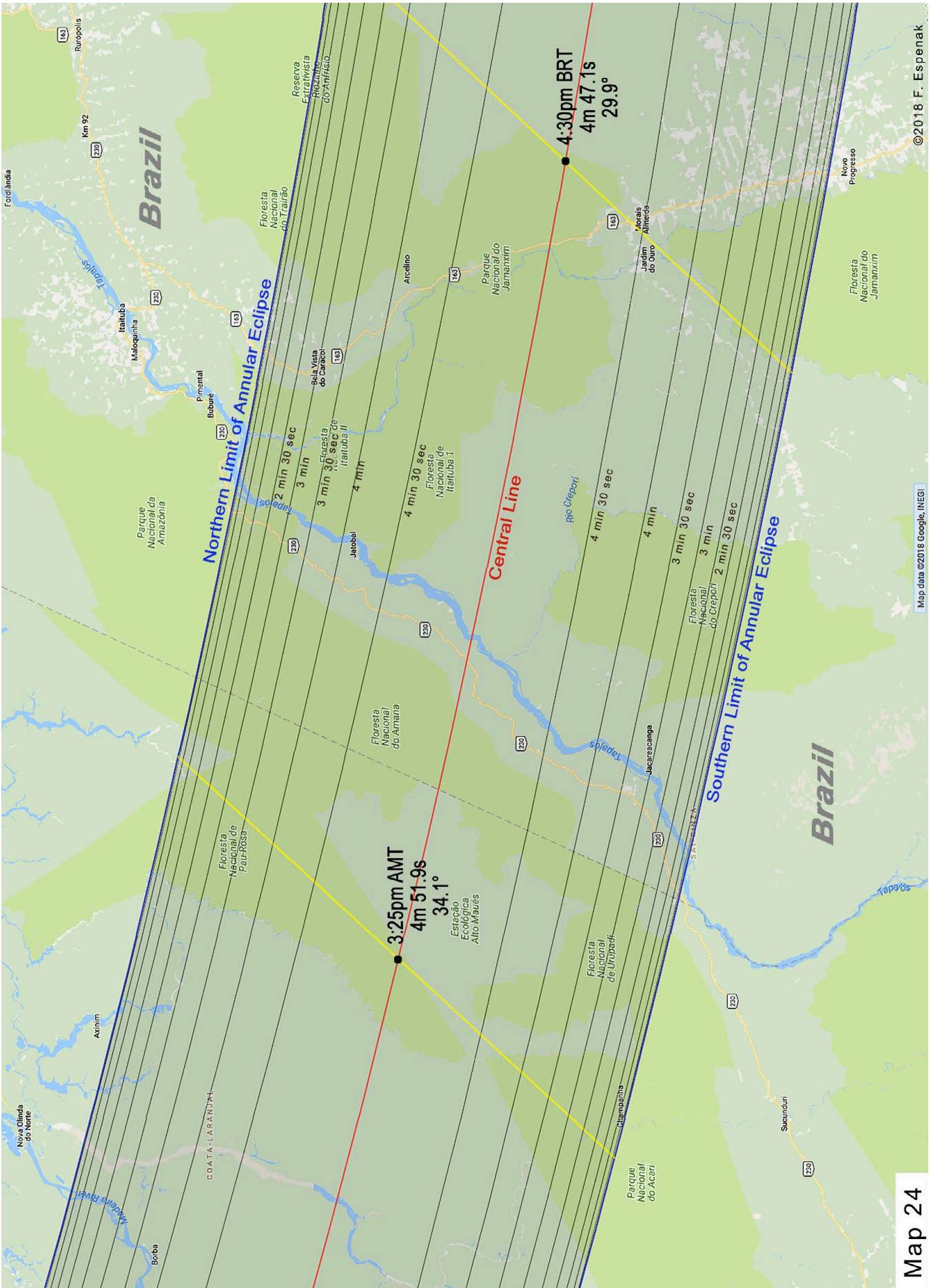




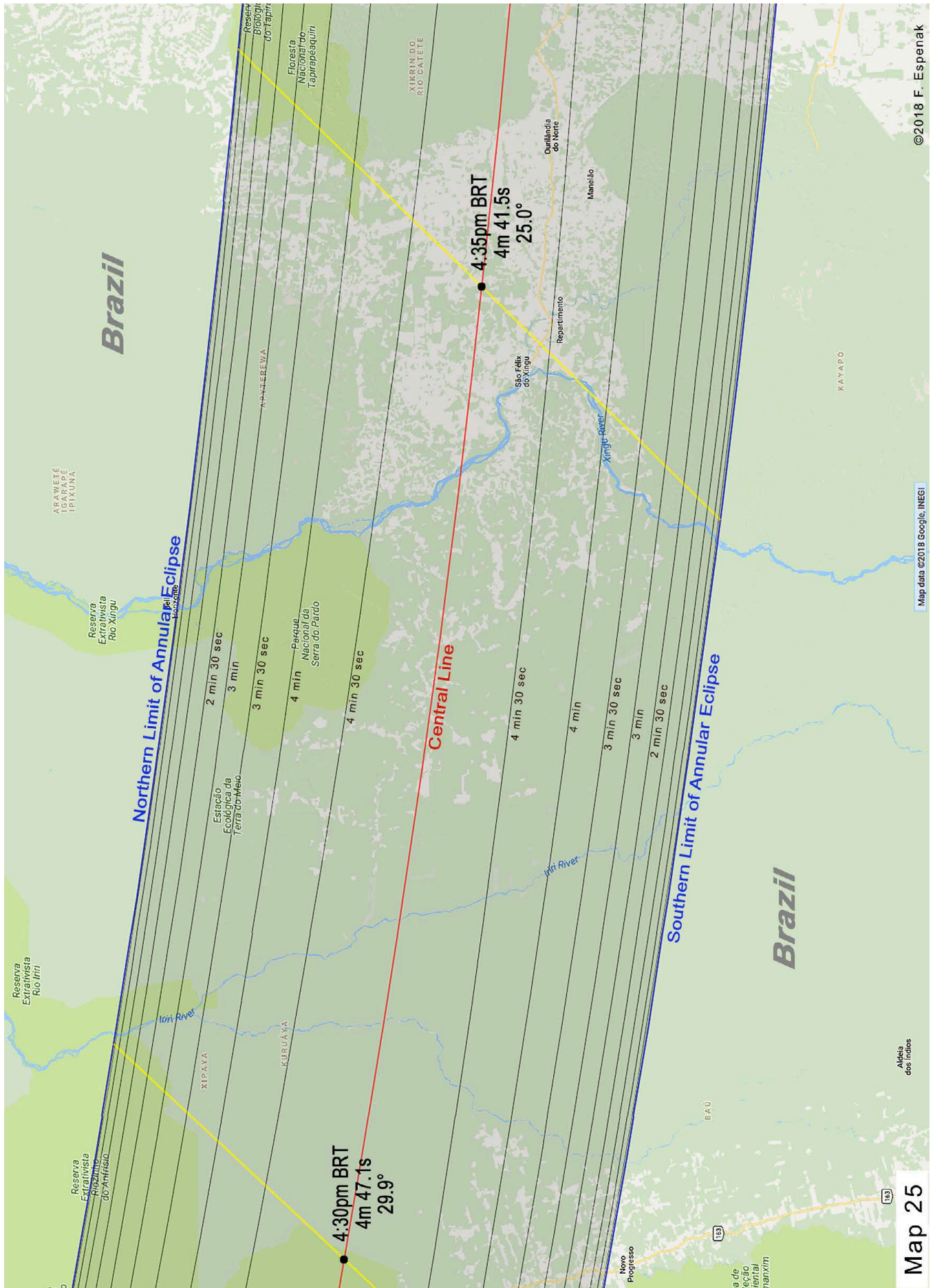


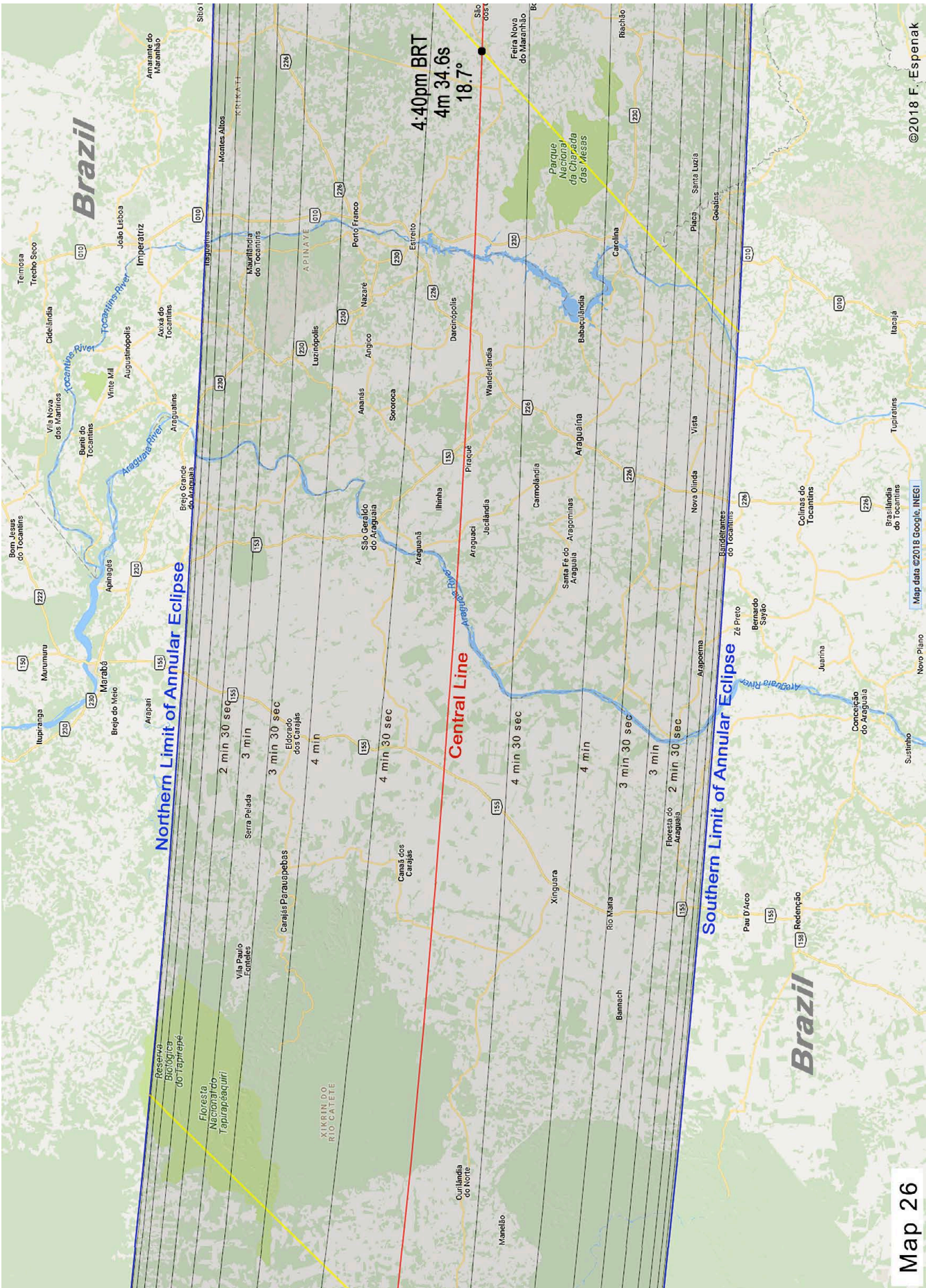
Map 23



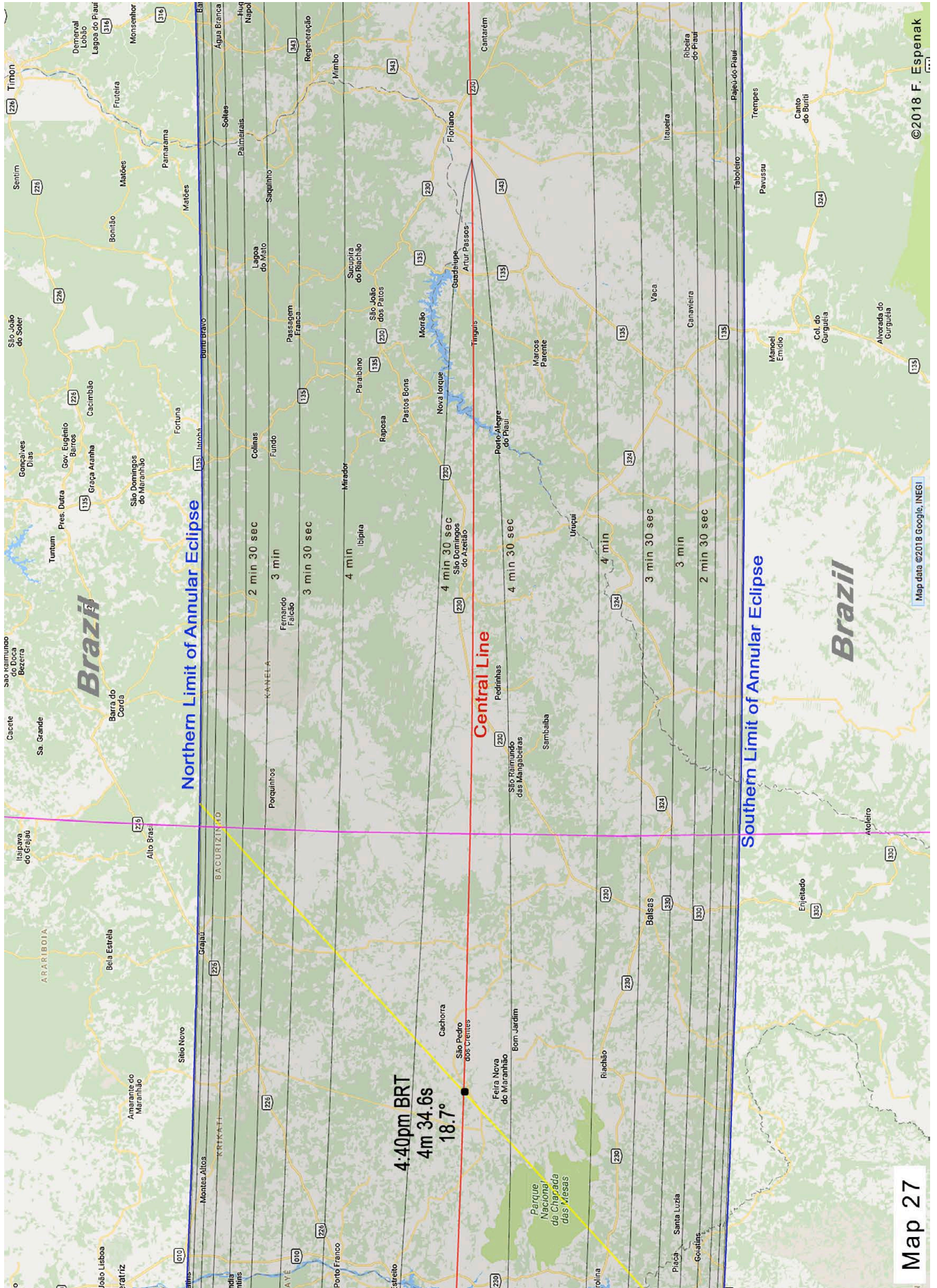


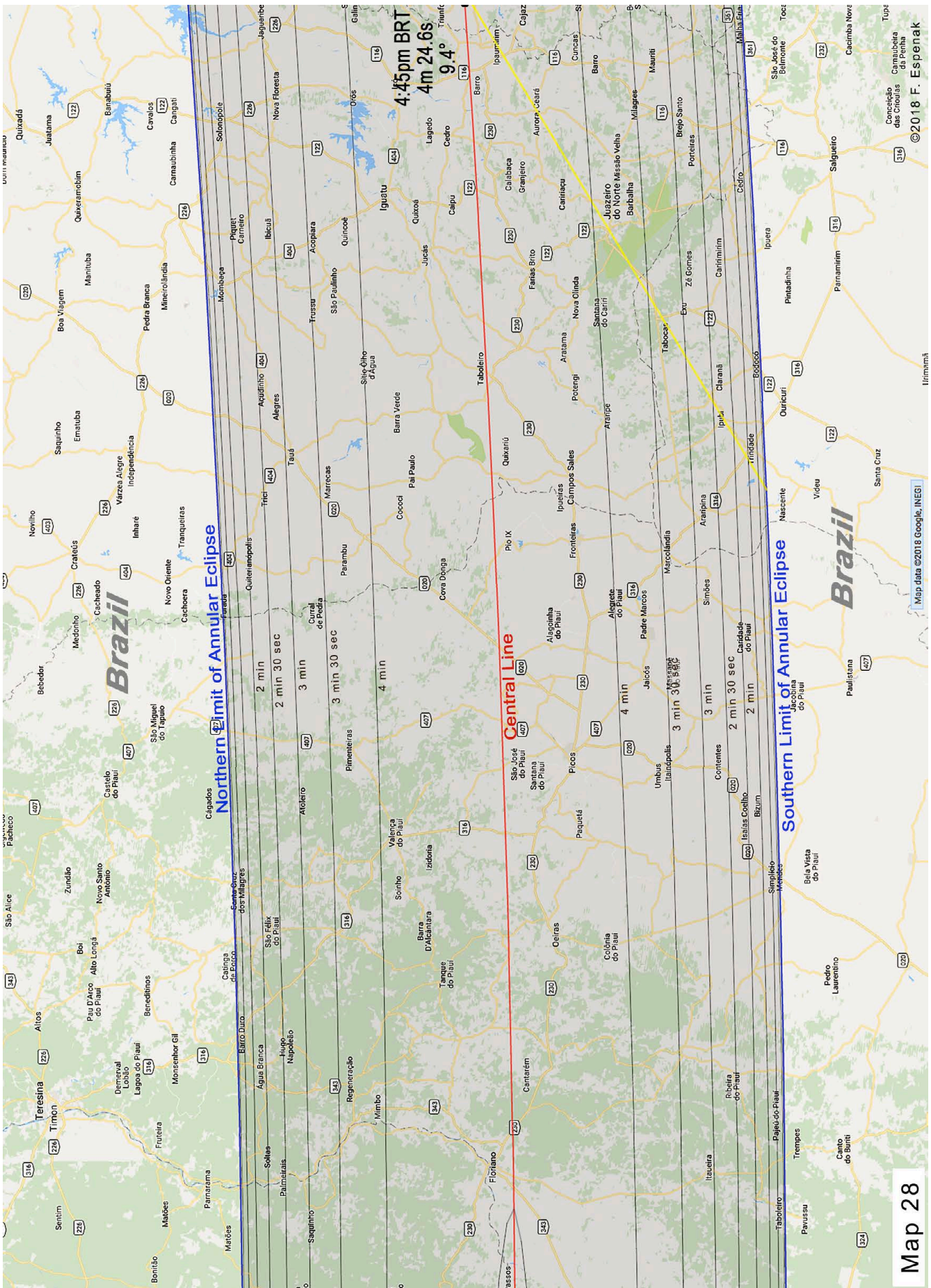
Map 24

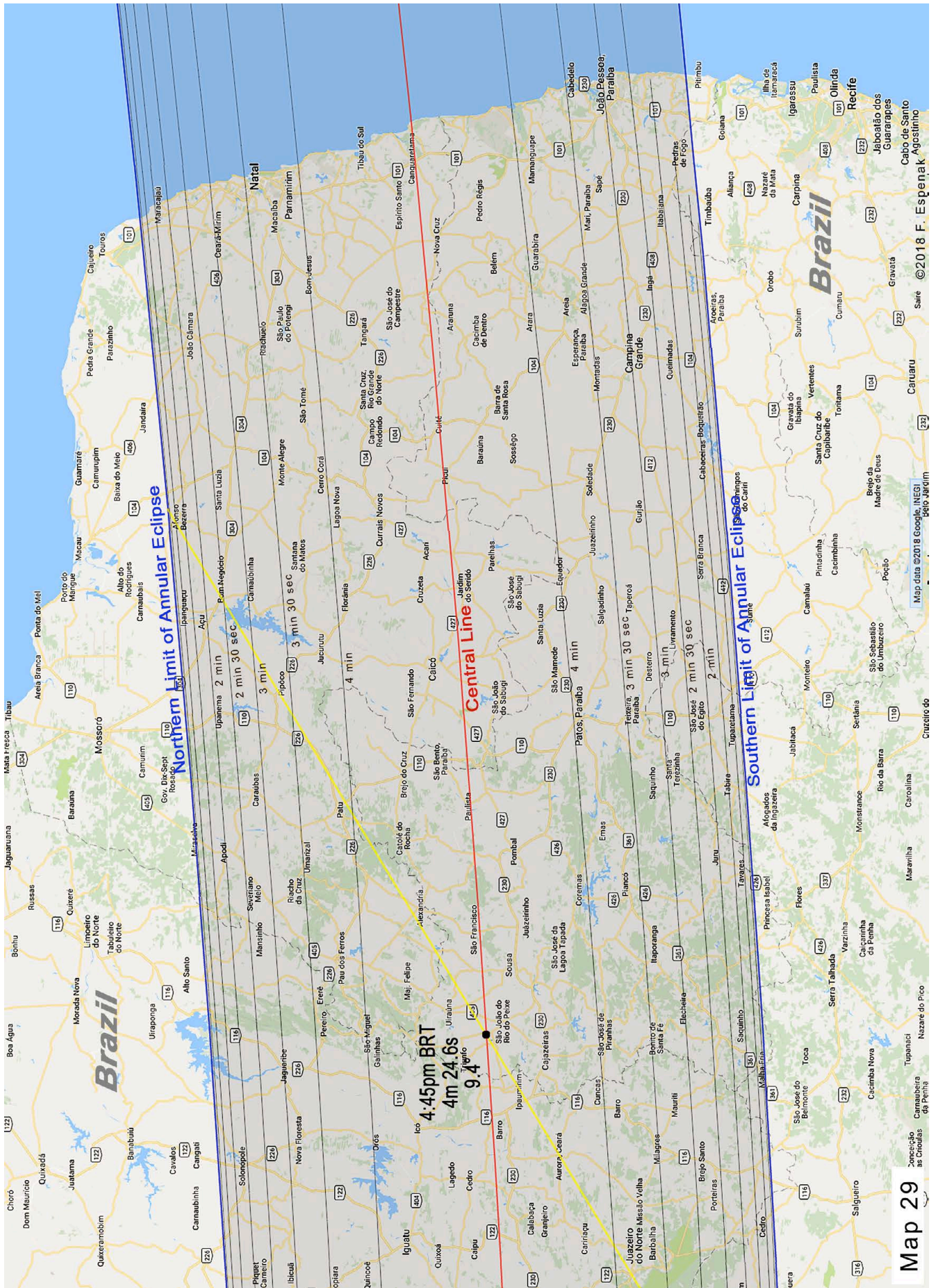




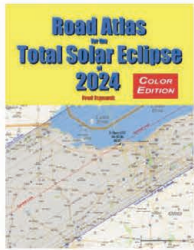
Map 26



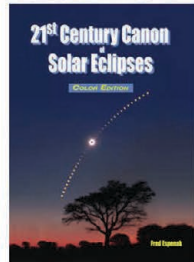




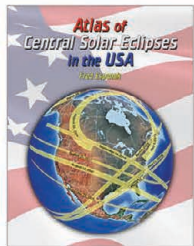
## Astropixels Publications



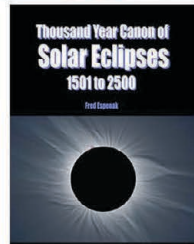
**Road Atlas for the Total Solar Eclipse of 2024** (Fred Espenak) contains a comprehensive series of 26 high-resolution maps of the path of totality across the USA, Mexico and Canada. The large scale (1 inch = 22 miles) shows both major and minor roads, towns and cities, rivers, lakes, parks, national forests, wilderness areas and mountain ranges. The duration of totality is plotted in 30-second steps, making it easy to estimate the length of the total eclipse from any location in the eclipse path.



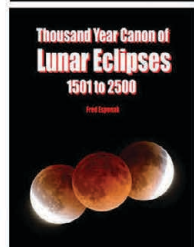
**21<sup>st</sup> Century Canon of Solar Eclipses** (Fred Espenak) contains maps and data for all 224 solar eclipses occurring during the 100-year period from 2001 through 2100. Appendix A is comprehensive catalog listing the essential characteristics of each eclipse. Appendix B contains maps depicting the geographic regions of visibility of each eclipse with 12 maps per page. Appendix C has detailed full-page maps of every eclipse from 2017 through 2066. Appendix D plots the track of every central eclipse (total, annular and hybrid) on large-scale maps with countries borders and major cities.



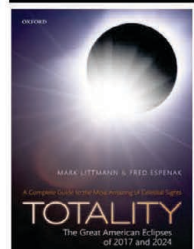
**Atlas of Central Solar Eclipses in the USA** (Fred Espenak) contains of a series of 499 global maps showing the track of every total and annular solar eclipse across the USA from 1001 through 3000. It is accompanied by a catalog that lists the major characteristics of each eclipse. A set of 20 detailed maps, each covering a 50-year period and centered on the lower 48 states, shows the path of every total and annular eclipse. The maps include state boundaries and major cities. These maps also cover southern Canada and northern Mexico.



**Thousand Year Canon of Solar Eclipses 1501 to 2500** (Fred Espenak) contains maps and data for each of the 2,389 solar eclipses occurring over the ten-century period centered on the present era. A comprehensive catalog lists the essential characteristics of each eclipse while a series of global maps show the exact geographic extent of each eclipse.



**Thousand Year Canon of Lunar Eclipses 1501 to 2500** (Fred Espenak) contains diagrams, maps and data for each of the 2,424 lunar eclipses occurring over the ten-century period centered on the present era. A comprehensive catalog lists the essential characteristics of each eclipse while a series of diagrams and maps illustrate the Moon-shadow geometry and geographic regions of visibility of each eclipse.



**Totality: The Great American Eclipses of 2017 and 2024** (Mark Littmann & Fred Espenak) is the ultimate guide to the most stunning of celestial sights, total eclipses of the Sun. The book provides information, photographs, and illustrations to help the public understand and safely enjoy all aspects of these eclipses including how to observe a total eclipse of the Sun, how to photograph and video record an eclipse, why solar eclipses happen, and more. Several chapters focus exclusively on the total eclipses of 2017 and 2024 though the USA.

For complete details and ordering information on the above *Astropixels Publications*, visit:

***[astropixels.com/pubs/](http://astropixels.com/pubs/)***